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PROCEEDINGS

OF THE

NATIONAL ELECTRIC LIGHT ASSOCIATION

AT ITS

FIRST ANNUAL CONVENTION, FEB., 1885,

HELD AT CHICAGO, ILL.,

AND AT ITS

SEMI-ANNUAL CONVENTION, AUGUST, 1885,

HELD AT NEW YORK CITY.

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OFFICERS FOR 1885.

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J. H. YARBOROUGH, ... Nashville, Tenn.
E. R. WEEKS, ... Kansas City, Missouri.

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WM. A. HOVEY, ... New York.
(Resigned August, 1885.)
H. E. RHINEHARD, ... Baltimore, Md.

TREASURER.

SUMMERFIELD BALDWIN, . Baltimore, Md.
(Resigned August, 1885.)
CHAS. COOPER, ... Brooklyn, N. Y.

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GEO. S. BOWEN, ... Chicago, Ill.
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FRANK RIDLON, ... Boston, Mass.
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PROCEEDINGS

OF THE

NATIONAL ELECTRIC LIGHT ASSOCIATION

AT THE

ANNUAL CONVENTION.

MORNING SESSION.

GRAND PACIFIC HOTEL, CHICAGO, February 25th, 1885.

THE Convention was called to order at 11 A.M. by Mr. William A. Hovey, of the *Electrical Review*. He stated that a call had been issued at the request of a large number of those engaged in the electric light business with the purpose of perfecting a permanent organization, to meet in Annual Convention in order to discuss such questions as would be of interest and benefit to all members of such an organization. Continuing, Mr. Hovey spoke as follows:

In the first place this Convention should not consider the relative merits of different lamps. The various systems must stand or fall by their merits. It is a fact which I have ascertained in the course of my travels throughout the country, that the electric apparatus is not the only factor to success. To make my meaning a little more plain, let me say, I can point to companies using a certain system, which are succeeding in making money, giving good light, increasing their business, and doing their

business in a way satisfactory to their customers and the stockholders. But I could also point to other companies using precisely the same system who are giving a poor light, losing money, losing business, and being overcome by the opposition. Therefore, I say the system used is not the all-important factor. I made a remark to a genetleman a few hours ago, which I think can be substantiated by the facts, that, taking two fairly good systems, the commercial success absolutely depends more upon the engine and boiler you use than upon the system. Why? Because after you buy your electric light apparatus and put it up, it is there for all time, barring ordinary repairs. Your boiler and fire-box are used every day, using up coal that you have to pay for every day. More than this, your engine, if it is a good one, is doing its full duty. There is enough for us to talk about without in any way going into questions of the relative merits of various systems. I am in this business and all business related to electricity to stay. My hopes and aspirations for the future of electricity are unbounded. We will gradually get rid of a great many difficulties. One of these days the best electric light is going to be formed by taking the best in all the systems and putting them together as one system. That time is coming. When the electric light was first introduced it came in on a boom. Of course the boom came to an end. Then there was a period of what seemed to be depression, and there are in our minds many people to-day who feel that that depression still continues. You will find a parallel in the case of the oil business. We all, most of us certainly, remember the oil excitement. I suppose some of us dropped a little money in that operation twenty years ago. I did, I know. The oil excitement all went off and people began talking about other things. The fact is, there is more oil produced to-day than there was during the greatest amount of talk about the oil business. And so to-day the manufacturing companies are turning out and selling more electric light plants than ever before in the history of the business. That is an important question to be understood. The electric light is, as a matter of fact, succeeding, and I had the curiosity to look up the facts a little while ago. There have been many

electric light companies that have not paid large dividends to stockholders. Many closed out on account of the difficulties they had to contend with; but these difficulties are not anything to compare with the distractions and disappointments which the gas companies had to contend with in this country when they first started. This was some time ago and it is forgotten. Now there are other questions, gentlemen, which it seems to me, this Convention may fairly consider, because they come up every day, in the course of our business as electric light men. We are scattered all over the country. Each one of us is trying to solve these various problems in his own way. I never went into an electric light station anywhere, large or small, with a good system or a poor one, with good engines or bad ones, with good boilers or bad ones, that I did not learn something. There was always some one point which it was worth while knowing, even in such matters as the location of a station. One of the finest stations I ever went into in this country is handicapped for all time because it is built on the wrong side of the town.—I will not name the town.—Then there is the question of competition with gas companies. It is a legitimate and honorable competition. There is no reason why gas companies should not strive to put the electric light down. It is perfectly fair. And it is fair on the other side for the electric light companies to combine and counsel together how they can succeed. The question of the danger of the electric light has been wonderfully exaggerated, from interested motives and sometimes through ignorance. That there is a certain element of danger in the electric light there is no question. There is an element of danger riding on a horse-car, on a grip-car, on a railroad train, and in every element of civilization yet introduced there is a certain element of danger. There is also a certain element of safety, and it is a mere question as to which preponderates. Now, in the question of dealing with municipalities as to the right of way, some men have been very successful, and others unsuccessful. Those who have been successful have been deservedly so, and those who have been unsuccessful failed because they did not know how to succeed. I merely want to make one more suggestion; then I will sit down. It is this, there is no reason why in a Convention

of this kind there should be the least reluctance to tell our experience, and the benefits which have accrued from any cause or any policy. I take it, looked at in a large way, it is to the interest of the electric light companies everywhere, that not only the electric light companies in Boston, but the electric light company in Minneapolis, should succeed and have it known that they are a success. The two are in no way competitors. All the general successes on the part of electric light companies, made known to the public, raise a drain on the electric light and bring it into better repute, and tend by reflex action to help all the companies. Now, I take it, that this Convention is held upon the principle that some of us know what others do not. Let us in a friendly way compare notes, tell each other all we know, tell each other anything that has been a benefit to us and can be to others, and I think when we go home we shall all do so with increased knowledge. I have been requested to nominate Mr. BOWEN as Temporary Chairman of this Convention. I will now take the liberty of putting the question.

On the question being put to the Convention, Mr. Bowen was elected Temporary Chairman, and on taking the Chair spoke as follows:

Gentlemen of the Convention, I am certainly very much gratified to see such a large number of electric light men from all parts of this great Union gathered together to discuss a subject which is all-important to each one of us. We have passed through a year of most trying difficulties, such as I hope we may never see again. We are just now opening up upon a new year, entering into the management which shall be offered us by a new political administration, and I trust that an inspiring confidence of the people may bring to us improved business facilities, and that everything, electric light as well, will succeed during the coming year much more satisfactorily than it has during the past. I give you a most cordial welcome on the part of the people of the city of Chicago for coming so great a distance in order to discuss our troubles and trials, and also to consider our future hopes on the subject of Electric Lighting. Certainly the subject

of electricity is one so profuse and wonderful that I will not undertake to discuss that topic at all, leaving it for more instructive minds than my own. I look upon this matter simply and purely in its commercial phase. The question to my mind is: Can any man who has money to buy an electric light plant put it in operation, run it successfully, and declare a dividend? That is the question that comes to my mind, and seems to me to be the main subject, the outcome of whatever we may discuss. If it be proved that the electric light can be furnished cheaper than poor gas, if it become the opinion of the people that the electric light is better than tallow candles and kerosene oil, then the electric light is going to take the place of all the other useful articles that we have had offered us in times past. And now, without taking up your time or going into details as regards all the operations of an electric light plant, I beg to say that the Committee in Chicago, who have had charge of making some little preliminary arrangement to hold the Convention, have received a great many replies to a circular inviting your presence here. In them a large number of questions have been asked and suggestions made; and it seems to me it would be proper for this Convention to appoint a Committee to prepare such matters of interest as may properly be discussed by this meeting. Also a Committee on Credentials, and any other committee proper to be nominated at this session. At two o'clock this afternoon we will have a more formal reception. The Mayor of this city has been invited to come here to give you the right hand of fellowship, and extend to you a cordial welcome to the city of Chicago. He has accepted our invitation, and we will be much pleased to hear what he has to say. Without taking up your time further I beg to say the Convention is open for business. Motions are now in order.

Mr. Stanley, of the Bates Company, was nominated and elected as Temporary Secretary of the Convention.

Mr. Brown moved that a Committee on Permanent Organization and Credentials be appointed by the Chair, consisting of five members, which motion was adopted.

THE CHAIRMAN: The Chair labors under some embarrassment in naming committees, as he is quite unacquainted with all the delegates. He would be very much pleased if the Convention would assist him in forming this Committee by nominating proper persons for it. I would suggest Mr. Brown, of the Western Electric Company, as Chairman of the Committee on Permanent Organization and Credentials, and I would like to have four other names suggested.

Mr. Wadsworth, of Cleveland; Mr. C. J. Richards, of Racine; Mr. J. F. Morrison, of Baltimore, and Mr. Ridlon, of Boston, together with Mr. Brown, of Chicago, were appointed a Committee on Permanent Organization and Credentials.

THE CHAIRMAN: I have in my hand a list of the replies which have been received by the Committee in charge of making the preliminary arrangements to hold this Convention in Chicago. These embrace a large number of suggestions as to matters touching the operation, etc., of electric light plants, which it might be well to place in the hands of a Committee to prepare subjects for proper discussion. I will be glad to place these communications in the hands of such a Committee when appointed.

MR. WEEKS, of Kansas City, moved that a Committee of three be appointed on Programme, which was adopted.

Mr. Sperry, Mr. Brown, and Mr. Hovey, with Mr. Weeks as Chairman, were appointed as such Committee.

MR. MORRISON suggested that the Committee should be made up of men familiar with the electric light business, and said: That is the most important committee you are to appoint, and should be a larger committee than one of three. It ought to be selected with a view of getting out in some way the judgment of the different sections of the country. You have put on Mr. Sperry and Mr. Brown, of the Western Electric Company. While the latter, perhaps, is quite familiar with the work in detail, and Mr. Sperry is, as I am informed, a leading man in a new electric light organization, and Mr. Hovey, of the *Electrical Review*, I submit to you, sir, that allowing these gentlemen all the knowledge to which their different positions in life entitle

them, your committee is not broad enough, nor composed of material from which you can get work or information on an electric light. You have a very large number of replies, and in these are suggestions which involve the different details of the working part of the subject. This I gather from the remarks of the gentleman who called the meeting to order, Mr. Hovey. I supposed from his opening statement that the purpose of this meeting is to examine the working details of the electric light, avoiding the scientific part, and, therefore, I submit that the men actively engaged in the working business of the electric light ought to be the gentlemen who are gathered in that committee, and that the committee should take into its scope that class of men to classify these matters.

A motion was made that Mr. Bowen be added to the Committee on Programme, which was seconded.

One member thought a committee of five was hardly enough. He made a motion that a committee be appointed, composed of one member from each Electric Light System represented here, which motion was duly seconded and the amendment accepted by the mover of the resolution.

Mr. Weeks: So large a committee would be a hindrance to its operation. While I think that the operating, rather than the manufacturing companies, should be represented, it seems to me the number nine is amply sufficient; and had I known that the making of the motion would have constituted me chairman of the committee I would not have made it. It seems to me a committee of nine is as large as can conveniently confer together in order to get their ideas into such a shape that we can act upon them at the next session. All this committee has to do is simply to draw out a rough plan of procedure, deciding upon what topics it would be best for our Convention to discuss and consider at the regular meeting.

The Chairman: I think the gentleman would not desire to make a committee much larger than that. It would not go above nine to accept the motion made by the gentleman from Baltimore.

Mr. Weeks: I understood the gentleman to suggest that a member be appointed from every operating company here represented.

The Chairman: No; from each system. The intention is to have each system represented. I see no objection to that amendment.

The motion was adopted.

The Chairman: The Chair is now ready for nominations.

Mr. Powers, Mr. Weeks, Mr. Sperry, and Mr. Hovey were put in nomination.

Mr. Warren: In order to get out of the tangle, would it not be well to go all over it again and appoint on this committee, whatever number it be, persons representing each Electric Light System represented here, and take no one on the committee who does not represent an Electric Light System; and when a gentleman's name is suggested give his residence and which system he represents.

Mr. Warren was suggested.

Mr. Warren: I operate three systems, the Brush, Fuller, and the United States.

It was suggested that Mr. Morrison resign as chairman of the Committee on Organization, and that he be put on this committee as chairman.

Mr. Morrison: I shall decline to act as chairman of that committee. Let Mr. Warren be chairman. There is one thing I want to speak of with regard to Mr. Hovey, who spoke a while ago. I do not intend to exclude a manufacturer from that committee. I therefore name Mr. Brown of the Western Electric Company. Let us have that committee composed of men from whom we will be able to get information. We came here to do business and we shall be benefited, and be a benefit to all the people engaged in it. I did not come here for the purpose of advancing any one man's business. Now then the manufacturer possesses knowledge which the operative does not possess, and the operative in many cases possesses a knowledge which the manufacturer has no means of obtaining. Therefore a wise selection

of this committee will compel you to put upon it representatives from manufacturing companies. It would be wise to appoint on your committee, while selecting from operative companies, representative men, men from Chicago who have been familiar with the organization and the preliminary steps to organize this Convention. They certainly possess, and should possess, a wider knowledge of its intents and purposes than those of us who have come on short notice. I will name Mr. Bullock of Chicago, a representative of the Brush Electric Light System, as another member of this committee. That strikes me as the proper way to get at it. I do not think Morrison, from Baltimore, who is not familiar with the steps already taken and whose knowledge of Electric Light is far greater of the Brush system than of any other, should be on that committee.

THE CHAIRMAN: Do I understand Mr. Morrison declines to serve on the committee?

MR. MORRISON: Yes, sir.

THE CHAIRMAN: The chair understood you declined to serve on the Committee on Permanent Organization and Credentials.

MR. MORRISON: I do not want to serve on any committee. I want to say something.

THE CHAIRMAN: The Chair will ask for a nomination in the place of Mr. Morrison on the Committee on Permanent Organization and Credentials.

Mr. Baldwin, President of the Brush Company of Baltimore, was nominated as a member of the Committee on Permanent Organization and Credentials, and the nomination was confirmed.

THE CHAIRMAN: Now, gentlemen, we are ready to receive nominations for the Committee on Programme.

Mr. McDonald of Fort Wayne, Mr. R. J. Randolph, and Mr. Lewis of Racine, were nominated. Mr. Lewis declined to act, and nominated Mr. S. F. Badger of Chicago. Mr. Weeks of Kansas City, Mr. Reid of the Electrical Supply Company of Chicago, Mr. Sperry of Chicago, representing the Sperry Electric Light, and

Mr. C. C. Warren of Chicago, representing the United States, were also nominated.

Attention was called to the fact that there was already one representative, Mr. Powers, from the United States Company.

MR. WARREN: I do not want to serve on that committee, as Mr. Powers of Grand Rapids represents our system.

THE CHAIRMAN: Would you prefer not to serve on the committee?

MR. WARREN: I prefer not to serve on the committee.

THE CHAIRMAN: We want one more man.

Mr. Buckley of the Excelsior Company was nominated; and a motion was adopted that the Chairman be added to the committee.

THE CHAIRMAN: The Committee now consists of Mr. Powers of the United States, Mr. Brown of the Western Electric, Mr. Bullock of the Brush Company, Mr. McDonald of the Jenney Company, Mr. Randolph of the Vandepole, Mr. Badger representing the Thomson-Houston, Mr. Reid of the Electrical Supply Company, Mr. Sperry of the Sperry Company, and Mr. Buckley of the Excelsior Company.

THE CHAIRMAN: Has the Fuller Company a representative?

A MEMBER: Mr. Powers.

MR. SPERRY: I would respectfully withdraw in favor of Mr. Place, of Chicago, representing the Sperry Company.

THE CHAIRMAN: We will substitute the name of Mr. Place in the Sperry Company instead of Mr. Sperry.

MR. BADGER: I would like to withdraw from that committee. I use three different systems now, and I do not think it would be wise for me to accept an appointment.

THE CHAIRMAN: You have the ability to concentrate your ideas on one for the time being.

MR. BADGER suggested Mr. Crossman of the Thomson-Houston in his place.

On motion Mr. Badger's resignation was accepted.

THE CHAIRMAN: If there is no objection the Committee will stand that way, Mr. Crossman's name in place of Mr. Badger's.

A motion was made that the Committee on Programme and Business have leave to retire. Carried.

THE CHAIRMAN: That Committee will occupy my room, No. 34, at the conclusion of the meeting, and be prepared at 2 o'clock to report.

MR. HOVEY: The Committee on Permanent Organization may occupy room No. 32.

MR. BADGER moved that Mr. Hovey of the *Electrical Review* be added to the committee, which motion was seconded and adopted.

A MEMBER: May I ask the Chair to read the names of the Committee on Permanent Organization to see whether that will conflict with the business of the other committee.

THE CHAIRMAN: The names of the committee are Brown, Wadsworth, Ridlon, Richards and Baldwin.

A MEMBER: Is Mr. Brown on both committees?

THE CHAIRMAN: Yes, sir.

Mr. Scribner was substituted for Mr. Brown on the Committee on Programme, thereby leaving Mr. Brown as Chairman of the Committee on Permanent Organization.

A motion to adjourn to 2 o'clock was adopted, and thereupon members present registered their names in a book provided by the Secretary.

AFTERNOON SESSION.

February 25th, 1885.

At 2 o'clock the members reassembled in the club rooms of the Grand Pacific Hotel which had been assigned to their use.

After opening the afternoon session the Chairman addressed the members present as follows:

Chicago is an industrial city, and has a name that is world wide. We could not permit the opportunity to pass, when all the Electric Light representatives of the United States are assembled here, without extending a cordial welcome to the gentlemen who have made this long trip to come here for the discussions that may take place at this meeting. It is my pleasure, gentle-

men, on behalf of the Committee of Arrangements, to ask the Mayor of this city, Mr. Harrison, to extend a cordial welcome to you. I have great pleasure, gentlemen, in presenting Mayor Harrison, of Chicago.

Mr. Harrison: Gentlemen, there must be a growing impression, or a grown impression, with people from every part of the country that this is a very dangerous place to be in. Some of our own people, recognizing this prejudice, think that strangers coming here would not feel safe unless the Mayor (I suppose as the chief police officer of the city) should extend to you a welcome and a hearty greeting. President Bowen, I suppose, feels this and knows that if I give you this expression of kindliness you can go out at night with less fear to stumble over the snow drifts. But whether that be so or not, as Mayor of Chicago, it always gives me great pleasure to extend the hand of greeting to business men, to scientific men, to men earnestly endeavoring to promote the material or the spiritual welfare of the world. In accordance with this feeling I greet you here and hope that your deliberations will be careful and wise, and that out of your deliberations there may be more life. (Cheers and laughter.) You have to deal with the most subtle of all of nature's fluids. What it is no man knows; but you know about as much what electricity is as you do what heat is. No man knows what heat is, and yet all men deal with it. No man knows what electricity is, yet it looks as if in a little while it will become one of the common agencies of nature handled by man. A long time ago it was said "the wind bloweth where it listeth, and thou hearest the sound thereof, but canst not tell whence it cometh, and whither it goeth," and the same may be said of electricity. It is everywhere. It seems to pervade all things, yet no man can tell what the subtle fluid is. The gentleman who came to me last evening to request me to come here said, "Why none of us know anything about electricity; we do not know what it is that should discourage you." We have reason to believe that the mighty cosmic monsters, dashing through millions of miles in the mighty space, are but conveyancers of electricity, carrying it from sun to sun. It is everywhere. You rub your sweetheart's glossy

locks, and, lo! a spark springs out, if the spark be not generated. (Applause.) And what is it? I asked of a very intelligent electrician this morning just before I came here. (I generally make a pretty good speech when I have somebody to cram me just before I get up. I went down to Professor Barrett, and asked him to stuff me, but we had only about two minutes, and he did not do it.) Electricity has been known, I believe, for thousands of years; but what is it? As I said to Professor Barrett it is one of those subtle fluids which imagination can take hold of, and I was willing to say it is the breath of Deity. (Applause.)

All powerful, it is harmless when not too concentrated. You may fill this room with it. Likewise it hurts no one. Concentrate all the heat that is in this room in a small space, and it burns even to destruction. Electricity is harmless according to its mode of generation. You can pack a house full of it and not be hurt. A little wire may carry it in deadly intensity. It is for you to be able to work with it, so that it will be powerful and yet harmless. Probably some of you think I have not been as friendly to electricity as I might have been. A gentleman from Baltimore just now said to me, "Why this is the darkest town I ever saw." He is an electrician, and wants us to get up arc lights I suppose. (Applause.) I replied to him that Chicago people were like a glowworm, in that we carried our light always on our forehead, and could walk and get along where a Baltimorean could not. Some have thought that, as Mayor of Chicago, I have not been so friendly to it. That is not true. I believe, gentlemen, that you have to deal with that which will be, if it is not now, the mighty motive power of the future. You certainly have to deal with the mighty light-giving power of the future. (Applause.) But as the father of over 600,000 people, all looking to me for protection (laughter) (I can prove it by these reporters), I say we want electricity, but we do not want death dashing like a horrid monster through our streets. We want you to devise means by which you can convey your electricity harmlessly beneath the earth, and not stretch it over poles that may be destruction. We believe you can reach that end. What you have to do is to think for science, and not try to make divi-

dends too rapidly. (Applause.) We are now, in Chicago, fighting Telephonic and Telegraphic Companies; but we fight them always kindly. We fight their wrong methods, and rub them down when they give us good methods. The result of it is that nearly all the great trunk lines from the heart of the city of Chicago will be next spring, or by next summer, reaching the suburbs by underground conduits. We want to give you an opportunity to give us more light. We ask you, however, to devise means by which you can carry your monster beneath the surface of the earth, where it will not destroy. We know it can be done by men who show as intelligent faces as this company does. You will reach it. I believe that you are here—first in the interest of yourselves, next of the people at large and humanity. We welcome you, hoping that you will act for the interest of our mighty city of Chicago. We welcome you, believing that you are going to think wisely, calmly and prudently. The other day I went into the fourth story of one of our buildings, and talked to a man in New York city, talked kindly, heard his words. It is true he asked me if Chicago girls had big feet, but I heard it very distinctly, and resented it immediately. (Applause.) What a wonderful thing that is?

A MEMBER: The feet?

I remember once receiving a dispatch from Europe four hours before it was sent. (Laughter.) Receiving it at one o'clock, although it had started at five. That startled me. I was almost overwhelmed, when I sat down in an office here to talk to a man nine hundred and odd miles away, and recognized the different modulations of different persons' voices. What a startling thing it will be when bottled electricity will put a street car on the rails and send it whirling from the heart of Chicago to its suburbs. (Applause.) Or when you in New York will bottle up the power and send the cars along your elevated railroad without scattering oil on the bright garments of ladies and men down beneath. That is one of the things that will come. And you will have also the power of giving us light, not dangerous light. The glare of your arc light is intense; your incandescent is soft as the down on a woman's cheek. (Laughter.) All things are in the

power of man. There is nothing that God controls, except those few things he keeps within his own hands, that man with his genius cannot control. Electricity is one of God's motive powers that are given to us to handle for the good of God's creatures. You, gentlemen, are among the first to help to do it. I congratulate this first Convention, meeting here to-day to start a work that fifty years hence people will wonder that it thought what it was doing was surprising. What to-day will be a surprise, probably ten years hence, five years hence, will be but a simple tale to our children. All things are possible, provided human genius takes hold of them carefully, candidly, and honestly, to work out the mighty problems that the All Great Architect of the universe makes possible to mankind. Gentlemen, in the name of Chicago I welcome you here. We have but a cold welcome out on our streets, but our hearts are warm, and in the language of one who went before me, "We are always ready to take in all strangers." This time we will take you in kindly. I know Professor Bowen has a large heart, and he and the committee will make your time pleasant. You, gentlemen, will make your time profitable, and I greet you again. (Loud applause.)

The Chairman: I know, when we read the names one hundred years from now, we will want to have the Mayor of Chicago heading the roll on that page, page No. 3. (Applause.)

Mayor Harrison: That it may, I hope it will be kept in one of our own fire-proof buildings. We have gone through the fire and won't burn up again. But don't send it to New York or Baltimore, for there it will burn up.

The Chairman: We have in our presence an electrician whose name is world-wide. When I requested him to say a word to this Convention he told me he did not know what he should say, and I told him there would be some gentlemen here who would ask him a question. I refer to Elisha Gray. (Loud applause.) A man you will all be delighted to have say a word. Gentlemen, I have great pleasure in presenting to you Professor Gray.

Professor Gray: Gentlemen of this Convention. I have not had the advantage that the Mayor had of being stuffed be-

fore the Convention. If he were here, I would congratulate him that he had not been, because he undoubtedly made a better speech without the stuffing process, which I began at an early age. I can remember, when a small boy, cutting up the bottom of my mother's wash-boiler to make a galvano-electric pile, and I think, by the way, her zinc under the stove suffered in the same way to get the other element. And the thought in my mind was, if the Mayor had begun at that time—I do not know how old I was, it must have been something like fifty years ago—to investigate this subject of electricity, and had followed it all through its development to the present time, he would have seen so much that his mind would be a blank when he got up before an audience and attempted to make a speech on the subject. Therefore, I will not attempt it. But I was going to say further to the Mayor, he need not have any fear about any of these gentlemen here getting into trouble before night, because they all carry with them the electric light. Now, gentlemen, as a citizen of Chicago, I have a right, as such, to welcome a co-worker in this great work—the development of electrical science. Now I should be glad, as I said before, to say something to you to encourage you, but the attempt to say anything upon this subject would be sheer foolishness. I would not know where to begin or where to leave off. I said to the President, when he spoke to me, "I have no idea of saying a word when I go to this Convention." What shall I talk about; what shall I say? I can talk from now to the middle of next week if somebody will ask me questions about anything on which I am posted, but to get up and make a general speech without any idea of what I am expected to say, I am the poorest hand in the world. So, all I can say to you is, we are citizens of Chicago, and, as persons interested in the development of electrical science, we welcome you here. And I wish to say this, that you and I are to be congratulated that we live in this age. I have thought of it thousands of times. I am glad I live in this nineteenth century, in the midst of the development of the greatest science upon the face of the earth, from which we may expect the most. Now I do not think we are through at all. I think we are simply upon the stepping-stone, upon the threshold

of developments in the science of electricity and magnetism, which will come within the next ten, twenty-five, or fifty years. I think we are babes. We know nothing as yet; we know nothing of its possibilities. When you look back, if you live to be twenty-five, fifty, or a hundred years older, you will remember my words, and mark the progress made in that time. I cannot tell you what it will be. I have an idea in some direction, perhaps. In this age of development, we do not know what a day may bring forth, and we do not know who will bring it forth. As I said before, I welcome you and I congratulate you. I know that nothing but good to science can come out of the assembling of so many electricians interested in the development of this science. (Applause.)

Prof. Gray enrolled his name as a member of the Association.

The Chairman: I believe the next thing in order, is the report of the Committee on Permanent Organization. Is that committee ready to report?

Mr. Brown: The Committee on Organization and Credentials respectfully report as follows:

Credentials.—The Committee have felt the necessity, in this the first meeting of representatives of the electric light interests, of being liberal in the matter of requirements for attendance; and after some deliberation have concluded to report in favor of accepting as delegates to the Convention all those whose names are enrolled on the President's table; and all those who enroll their names and represent electric lighting and lights, and stay during the progress of this convention. We recommend the rules to govern this Convention to be those used in bodies of a like nature, *Cushing's Manual.*

On Organization.—The Committee nominates the following gentlemen as officers of this Convention: for President, J. F. Morrison, of Baltimore; First Vice-President, H. M. Cleveland, of Hartford; Second Vice-President, E. R. Weeks, of Chicago; Third Vice-President, J. H. Yarborough, of Nashville; Secretary, W. A. Hovey, of Boston.

Committee: Charles A. Brown, *Chairman;* George A. Wadsworth, F. Ridlon, S. Baldwin, C. J. Richards.

On motion the report of the committee was accepted.

THE CHAIRMAN: I do not think the report calls for a Treasurer of the Association.

MR. BROWN: The question of appointing a Treasurer was brought up, but after some discussion it was concluded that the officers being appointed simply for this Convention, not holding office after the Convention adjourned, there was no call for such an officer as Treasurer.

There being no further remarks, the report of the committee was adopted.

THE CHAIRMAN: Our distinguished friend from Baltimore will please take the Chair. (Loud applause.) Gentlemen, I have great pleasure in presenting to you Mr. Morrison, of Baltimore, your President.

THE PRESIDENT: Those gentlemen who make speeches have their peculiar line of business, those trading in electric light have theirs. We do not include Prof. Gray as one of the speech-makers, we look upon him as one of the workers. They have had their time, and the members of this Convention are now regularly assembled for the purpose of transacting such business as may come before it, looking to the advancement of the interests of those engaged in the subject of electric lighting. We are not especially here as public benefactors. We are here for the purpose of transacting the business set forth in the circular sent to us by the committee in Chicago. The Convention this morning appointed a committee to frame a regular order of business, and when that committee has reported, we will find out what work has been cut out for us. This does not prevent any gentleman from introducing, in its proper place, any business we are here to discuss and consider. It is customary to say, and I suppose I should say, that for such an honor as you have just conferred upon me, I feel myself under deep and lasting obligations. I suspect you have selected me for this place to keep me off the floor. It may be I talk too much, but I am not going to burden you with speech-making at all. We are here for business. Those who have come long distances want to get away again. We do not want to spend more time than is necessary. It is not an inviting city,

and it is too dark after night. So far as relates to Mr. Baldwin and myself, we have no business on the street after night, not because of our age, but on account of our early training. (Laughter.) I feel, however, the honor you have conferred upon me, and shall endeavor to discharge the duties of the position impartially, and I know if I make any mistakes they will be mistakes of judgment. The Convention is now ready for business.

Mr. Brown (handing the President-elect a gavel): I wish to present this gavel to you on behalf of the Western Electric Company. I have not prepared a speech of presentation, for my time has been occupied in committee work. I can only point out to you the fact that the gavel represents a commutator of an electric light machine, and we trust this Convention or Association may prove to be as cohesive in sentiment and feeling.

The President: The first business in order is reports of committees.

Mr. Brown: I would suggest that the Vice-Presidents be requested to come forward and take seats about the table.

The President: The gentlemen chosen Vice-Presidents will be kind enough to take seats at this end of the room. The first business in order is the report of the Committee on Programme.

The Chairman of the Committee: Gentlemen, the report of your committee, selected for the purpose of formulating business, is respectfully submitted as follows:

1. Incandescent lighting, particularly in regard to length of circuit upon which it can be run with profit.
2. Locating and avoiding crosses with telephone wires.
3. Power and its conversion into light.
4. Electric light globes and shades.
5. The best modes of connecting dynamos with power.
6. Electric lighting by water power.
7. Rates and rebates on electric lights by the year.
8. The use of electricity as applied to motors.
9. Where an electric light system requires No. 6 conductors, is it desirable to use No. 6 and No. 4 in the same line?

10. Will armatures become affected by frost when exposed in transportation?

11. Special insulation or guards between insulations of lines at dangerous points and places.

12. Street lighting, the best manner and modes of accomplishing it. Location of lights and running the circuits for the same.

13. Experience and results in the use of underground conductors.

14. Resolved, That the fireman should receive more pay than the engineer.

15. Help generally.

16. Experience of electric light companies in the use of copper-coated and bare carbons.

In submitting the above, your committee would respectfully suggest, that in the discussion of any subject, the time of each individual be limited to ten minutes. We would also suggest that any person, indulging in a discussion of a partisan nature, should be called to order by the Chair.

On motion, the report of the committee was unanimously adopted.

The President: The first subject for consideration before the Convention is: "Incandescent lighting, particularly in regard to length of circuit, upon which it can be run with profit."

Mr. Weeks: Before proceeding with the discussion of the topics suggested, I would like to make a motion to extend a vote of thanks to Mr. Hovey, Mr. Bowen, and their associates here in Chicago, for the work they have done in organizing and getting this Convention under way. The motion being seconded, it was unanimously adopted.

The President: Mr. Powers will open the discussion of the first subject, "Incandescent lighting," etc. Is Mr. Powers present? In his absence, we would like to hear from any other gentleman posted on that subject.

Mr. Warren was requested to address the Convention.

Mr. Warren: I represent simply one particular Company. It is not to be expected that I can enter into a discussion of the subject at all. In fact, I myself have had but little experience,

and therefore, must be excused from discussing that particular subject. I will ask, whether Mr. Johnson is here, the engineer for the Edison? (No response.)

MR. BOWEN: The gentleman who represents the Muskegon light I think could discuss that subject with some interest.

THE PRESIDENT: The Chair desires to say at the outset that time is short and somewhat valuable. It is not necessary for any gentleman who knows anything upon the particular question presented for discussion to wait until called upon. It is expected when a question comes up that you will lay aside for the time being that bashfulness that is inherent in ordinary electric light men, and step up and say what you have to say, then sit down and give somebody else a chance. If any gentleman here is posted on "incandescent lighting," let us hear from him; if not, we will pass that question and take up the next. All are "arc light" men, I suppose. We will pass that question.

A MEMBER: I suggest that the subject might be called up at some other time.

THE PRESIDENT: Simply passed, that is all. "Locating and avoiding crosses with telephone wires." Mr. Goldthwaite, of Adrian, Michigan.

MR. GOLDTHWAITE: This question was suggested from the fact that trouble has arisen on account of the induction from an electric light wire on the telephone of some one who is furthest from the light station.

MR. BROWN: I received a letter from Mr. Hibbard, the superintendent of the Wisconsin Telephone Company, which bears directly on this subject.

WISCONSIN TELEPHONE COMPANY, MILWAUKEE, Feb. 24, 1885.

DEAR SIR: I have been interested in the proposed Electric Light Convention, and feel that some telephone man should be present to take up, if necessary, the discussion relative to overhead wires. Our complaint against the electric light companies is that, in a number of instances, they have disregarded our rights entirely. They have built lines along the same side of the public street with the telephone wires, either up above our wires or under-

neath them. It is well known that there is a heavy induction from electric light wires to the telephone wires, and as a result we have loud and disturbing humming noises on all of our telephones in the localities to which I refer. It appears to me that the electric light companies in doing this have been overreaching and taking unwarrantable liberties. I hold that they have no more right to interfere with us in this way than they have to break down our wires entirely. More than this, it is well known that the arc light is generally a dangerous thing when near grounded wires of either telegraph or telephone. As an instance of this, I have to mention an occurrence at our exchange at La Crosse, Wisconsin, some year and a half ago, shortly after the establishment of the Brush electric light in that city. Owing to bad insulation or faulty adjustment of a lamp by an electric light inspector, the arc light wire came in contact with our telephone wire running into a livery stable. As a result, when the light was started, a brilliant flash was noted in our central office, and the annunciator coil on that line was burned. At the livery stable things were decidedly warm for a few minutes. An eye-witness at the time alleged that the flames were ten feet long, and that they shot directly out of the telephone and transmitter. This probably was a trifle exaggerated. As a fact, however, the magnetic bell was completely burned, and the transmitter and hand telephone were entirely ruined. More than this the wood-work back of the telephone and up along where the office wires ran was badly blackened and the ground wires were burnt entirely off. Enough has been shown, I think, in the experience of telephone companies with the electric light, to prove that there is danger in a too great proximity. We have no desire to place any impediment in the way of our new neighbor, the electric light business, but while we wish to be neighborly, I think it best to understand that we should be next-door neighbors, and not attempt to live in one house. Where a telephone company has an ordinance giving it right of way to build its lines and wires in the streets of the city, and places the lines under this ordinance, I hold that it has the exclusive right to build its lines on the particular side of the street which it occupies, and that it is certainly discourte-

ous and entirely illegal to have any electric light company attempt to hang wires on the same side of the street, when it is well known that by so doing they endanger wires and possibly buildings, and are a direct means of disturbance to the telephone lines.

Yours truly,

A. S. HIBBARD.

MR. WADSWORTH: I would like to hear from Professor Gray on that subject.

PROFESSOR GRAY: Will the gentleman make the subject a little more definite?

The President handed the letter to Professor Gray.

THE PRESIDENT: The letter read by Mr. Brown of the Western Electric Company opens up a broader field than suggested, and yet should be fairly considered. It gives you a starting place which many of the gentlemen want, and there is room enough for you to defend yourselves. The letter is full of unjust charges and unfair statements.

PROFESSOR GRAY: I do not know that there is any answer to your question. It could be felt a very great distance. The question to be determined is at what distance you must go in order to practically get rid of the effect. Now, under ordinary circumstances, of course you ought not to feel it on the other side of the street, I mean feel it so as to disarrange the work of your line, but if the two wires are strung on the same set of poles and even four or five feet apart, the telephone will feel the electric light seriously, especially if there is much current, as there is always. I have had considerable experience with the Harmonic Telegraph which illustrates the same principle. The dynamo produces a sort of tone, a very low note in a humming sound. The Harmonic Telegraph does the same thing only of a higher pitch. These tones will be felt across on the parallel wires on the other side of the street, and felt very decidedly in telephones, although not to such an extent as to render the telephone inoperative, yet if they do run together on the same side of the street for any considerable distance, even a short distance, it is so loud that it is almost impossible to use the telephone while the tones are passing.

We have the same difficulty with the electric light wire only in a little different shape. All these things of course should be avoided, but it involves care and expense. You can lay wires side by side. You may say I am biased because I am somewhat connected with an underground company here, but what I say is wholly from an unbiased standpoint. It is possible to lay wires in the ground, and so protect them as to prevent induction that will be strong enough to hurt anything, even though those wires lie close together, even within a few inches or a foot or so. You must have some conducting substance between the two to get off this induction. I have tried the experiment where the wires have been inclosed in lead pipe, and where telephone wires lay by the side of them without any interference. I could hear it, but not enough to do any damage, not nearly so much as we now hear from the ordinary telegraph wires. The effect would not be so great.

A MEMBER: At what distance?

PROFESSOR GRAY: Half a mile or a mile. But of course there is a way to prevent induction into telegraph wires if a metallic circuit is used. That of course costs the telephone companies two wires instead of one. Now I am not practically an electric light man, so I am open to correction at any time. I believe the electric light always runs on a metallic circuit. Then, there is no danger from grounded currents. You would have great danger if electric light wires were grounded. I do not care if you ground them half a mile, there will be "*back lash.*" You can hardly get far enough away from it and not feel it. That of course is not a question to be considered with the present arrangement of circuits. It is only with the induction. Now, that can be done in one, two or three ways. Of course, speaking of crosses with overhead lines, there is no way to prevent that where they mass together, and when a line crosses another, except that one or the other wire should be well insulated. We all know it is impossible to get wires so well strung that they will stand storms. In stringing wires, the wire which is most likely to stand should go uppermost. For instance, a telephone wire is more likely to fall than an electric wire from the ordinary troubles which occur, and

it should be under the electric wire. That is a question you know more about than I do, those of you who are in the business, and have to take care of them every day. I merely throw that out as a suggestion. Where wires cross each other at right angles, there is no induction, it is only where they run parallel to each other that the induction trouble occurs. Now I would be glad to answer any question that any one has in mind that I am able to answer.

A MEMBER: I would ask Professor Gray if, in his opinion, a telephone properly equipped with a lightning arrester will not arrest this electric light current?

PROFESSOR GRAY: No, sir, I do not think a lightning arrester has anything to do with it. That is a wholly different question.

A MEMBER: I am assuming, that the noise from the induction from the dynamo is so great you cannot talk over a telephone wire.

PROFESSOR GRAY: You cannot attach your electric light wire to a telephone wire. I can say that sometimes there is no perceptible difference in induction.

A MEMBER: I mean as a protection to the telephone, or protection from injury to the operator at the telephone.

PROFESSOR GRAY: In case of a cross?

A MEMBER: Yes, sir.

PROFESSOR GRAY: I doubt if that would be any serious help to you. The electric light current is usually a current of a not much higher tension than the ordinary telegraph circuit, and a current jumping on the lightning arrester might protect it to a certain extent, but on a short circuit, as telephones usually are, it would be a great deal easier to get the current at the instrument through the terminals, than to get it through a lightning arrester. I doubt whether that would be any very efficient help in a case of that kind.

A MEMBER: How about a fusible plug?

PROFESSOR GRAY: I think about the time a fusible plug acted, this "ten-foot fire" described in that letter would have taken place. It would then be too late.

A MEMBER: I would like to ask this question so as to find out

whether we are in error. We are operating a plant in Racine, and use a high tension current. The Telephone Company was given permission in one instance to run double lines, two wires on our poles. They vary in height from two to three feet, and frequently run within half an inch or quarter of an inch to the electric light wire. We do not notice any induction or cause of complaint by reason of this proximity to the electric light wires. I would like to get your views in regard to the high tension current.

The PRESIDENT: Do I understand the gentleman to say he has no induction from the generator?

PREVIOUS SPEAKER: None whatever.

PROFESSOR GRAY: You have the two wires metallic circuit, so to speak?

PREVIOUS SPEAKER: We have metallic circuit.

PROFESSOR GRAY: Running close together?

PREVIOUS SPEAKER: We have one wire on one wall, and the other wire on the other wall, and a double telephone wire run within a half or a quarter of an inch of the positive circuit.

PROFESSOR GRAY: In that case you ought not to have induction—if the telephone wires are close together and in the same circuit. You have the same induction in one as in the other, and you have the same power working together, from which, if they are equal, there is no result.

A MEMBER: In that case there would be no induction?

PROFESSOR GRAY: The induction is there, but one is equal to the other, and both currents running in the same direction, when they meet are neutralized.

A MEMBER: If we had a third wire, one positive and two negative, would there be any induction in that case?

PROFESSOR GRAY: I think you might make one return wire take care of two or more telephone wires. I speak of return wires taking the place of the ground.

MR. HASKINS: Mr. Gray, I would like to ask one question. In the case of a cross between an electric wire and a telephone wire, would there be any danger of the current escaping to the

ground through the telephone wire, provided there was no other ground to the electric wire?

PROFESSOR GRAY: Assuming that the electric light wire is a large one, and thoroughly insulated from the ground, it is almost impossible with a high tension current to get an effect on the telephone wire through the ground, even if it came in contact, for you have a metallic circuit for the electric light wire which is thoroughly insulated from the ground, and offers but little or no resistance in the circuit.

A MEMBER: I would like to ask a question. Now, inasmuch as in the telephone we have this difficulty with the singing commutators, I would like to have the Professor's idea as to telephone lines. What would be the best remedy for the singing from the commutators, which we have all heard on a telephone wire?

PROFESSOR GRAY: If remedied at all, it must be done in the dynamo machine and commutator; to so arrange it that there is no disagreement of the current, no change from one to the other, if that is a possible thing. In other words, if you can make a safe speed of current you have no induction, because induction only occurs when there is a rise and fall in the primary or inducing current. You may have current of any power whatever, if it is flowing smoothly, no rise or fall in it; then the effect produced is static, and produces no noise in the telephone. So you can overcome the difficulty, if possible to be done, by making your electric-light current a perfectly smooth and even one.

MR. BUCKLEY: We run our electric wire out and return on the same set of poles, and we find we have no difficulty through an induction on any of our telephone lines. By running a wire in return, on the same set of poles, we thereby prevent an induction on the telephone wire and telegraph wires on these poles.

PROFESSOR GRAY: You can see the reason for that. One would be positive and the other negative, and there would be two producing wires—one a producing positive and the other a producing negative wire.

A MEMBER: Is not that a simple method to obviate the difficulty?

Professor Gray: I should say that would be a very simple method.

A member: We find that to be effective in regard to the protection of our wires. I saw this in a storm we had some years ago. I was requested by the Mayor of Boston to discontinue the running of electric lights that night. We all consented to do so. On the inspection of our lines, and I believe the other electric light lines, they were found to be perfectly intact. We cleared our own wires of all telegraph wires falling on them. I think one of the most prominent things we have to discuss, and act upon, is the stability of our structure on which our lines are placed.

Mr. Hammett: Is not much of this so-called induction on telephone lines caused by leakage from the electric-light circuit, through their not being perfectly insulated and coming back through the ground on the telephone?

Professor Gray: If you have a metallic system in the electric light, it has no business there; it is trying to get back on the other pole, and is not supposed to be connected with the ground. It does not go to the ground at all.

A member: In most cases the dynamos themselves are grounded.

Professor Gray: If they are grounded at any point you get a circuit.

A member: Dynamos are generally slightly grounded.

Professor Gray: When they are grounded, of course there is danger of getting on the telephone wire through the ground.

A member: How far can this induction be carried; how far must the electric light wire be from the telephone wire?

Professor Gray. It is said if you drop a pebble in the ocean the wave goes to the shore, and if the shore be far enough away it would go on to eternity. Now induction is just like that. It is infinitely great as to the distance it will induce, and of course as the distance increases the effect is diminished very radically. You know the mathematical ratio of squaring the distance, and you can figure that out just about as well as anybody else, but you can never theoretically get out of its influence. The mag-

netic feel goes on to infinity, unless it is cut off some way or other.

A MEMBER: There is a circuit on the west side of this city, along the face of a building on a street. There is an arc light wire burning, perhaps, four or five lights within a distance of four hundred feet. Outside the curbstone is a line of poles on which there are telephone wires, and the poles are at least thirty feet high. These telephone wires run from five to six squares from that point into the telephone office. Wires running still further west and not connected with them except through a switch-board, receive induction from that dynamo. The sound is very plain, very sharp, and it is easily to be distinguished. The distance from the electric light wire to the telephone wires must be at least twenty or twenty-five feet.

THE PRESIDENT: You have trimmed all around the edges and have not got to the subject of this letter yet.

The President hereupon called Mr. Gilbert to the Chair and took the floor himself.

MR. MORRISON: I hoped some one else would take up this subject. I am friendly to the telephone people, but it is always with a feeling. The author of this letter has placed himself in an unpleasant light. His letter shows a prejudice against all those engaged in electric lighting. The question of induction has been a bugbear. Professor Gray has gone very scientifically *around* it, without saying very much about it, and he has done that in answering questions propounded to him, all of which seem to have been directed to an effort to make the telephone side of the question look well without touching our business. [Laughter.]

The electric light business has nothing new in it, except the method of applying it. The light-house at *Cap de la Hève*, France, the first electric light-house, was established more than forty years ago, and when established it was a perfect light, and is running to-day upon the same plan, and with the same machine. It was made by the *Compagnie l'Alliance* of Paris. Therefore there is nothing new about the electric light business except some of the methods of applying it. It is only four or five years since

it was started by Mr. Brush of Cleveland inventing the machines and lamps for lighting large areas. The use of the light then became quite general, and thereupon, as in this case, came an outcry from the telephone companies about "trouble from induction," etc. I know cities, unlike Chicago, where people are glad to have the facilities which telephones and other electric appliances afford. Even at the expense of a little unsightliness they have allowed the construction of telegraph and telephone lines on both sides of many of the principal streets. This statement applied, up to within a year ago, to New York, Philadelphia, Cincinnati, Baltimore, and all the principal cities where people desire these advantages. It is no longer a luxury. It is one of the necessities of everyday life, and men bank just as much on the facilities offered by the telephone and telegraph to-day as any other method which enables them to save money. They must have these things. A telephone company occupies the two sides of a street. Now an electric light company comes along. The telephone company begins a great outcry against it. Up to the present time I have never discussed the feasibility of placing the wires under ground. I do not even now care to discuss that phase of the business, particularly as in Baltimore we have our wires all overhead. The case which I call to mind was the protest entered by the president of the telephone company against the use of electric light wires on Gay street. The telephone company occupied both sides of the street. The electric light had the right of way by ordinance from the City Council, and under the provisions of that ordinance proceeded to erect poles and string wires among those of the telephone company. I explained to President Davis, of the telephone company, that the electric light company had come to stay; that they were travelling exactly the same road which the telephone company had travelled, except that it was not as pleasant a road nor as profitable a one. We talked the matter over, and it was settled that we were going to build wires on that route. Within the last twelve months we have given the right of way to telephone companies in the city of Baltimore to run their wires on our poles, side by side with the electric light wires. In the electric light station

in Baltimore are four telephones. The Bell Telephone Company serves the wires, running directly into the station, up to the switch-board, where the electric light wires come in. They have been in service for three years. Now, then, you *do* get induction; you *do* have all this sound like the crackling of burning a stick under a pot; you *do* have the humming of all the various intonations, which have made the reputation of Professor Gray, who graded them from one down to another, and turned them to practical use; and you *do* have all this scale of notes; but the human voice passes over all those sounds just as clearly and distinctly as if you were talking face to face. You will pardon me for referring here to the gentleman who related his experience about induction. Now, then, this bugbear of induction is practically disposed of amongst those who are brought face to face with the problem. We cannot come to Chicago to settle that question. This with all due respect to the gentlemanly inspector of telegraph wires and things in Chicago. You haven't got a chance to settle that question. You never had that chance, because you have no electric light wires.

Mr. Haskins: I think you are laboring under a mistake. My object was merely to answer somebody about how far that induction comes. It does not interfere with the conversation over the lines. I was merely illustrating the distance the influence could be felt.

Mr. Morrison: It travels to infinity. Let me hunt up the language of this letter. Here it is.—"It is well known that there is a heavy induction from the electric light wires on to the telephone wires, and as a result we have loud and disturbing humming noises on all of our telephones in the localities to which I refer. It appears to me that the electric light companies in doing this have been overreaching and taking unwarrantable liberties. I hold that they have no more right to interfere with us in this way, than they have to break down our wires entirely." This is the gist of what I am coming to directly. That is a broad statement made by a gentleman who certainly never thought it was coming before this Convention for consideration. It is addressed to Mr. Brown of the Western Electric

Company, but, he says, not with the intention of having it printed. I have endeavored to show you that in a city where there are hundreds of miles of wire running on the same poles, we do not have half the trouble you do from the gold and stock reporting instrument, the induction from which goes through the telephone and does and did disturb the talking. I recollect very well when you could hear the click, click, of the Morse telegraph so distinctly that a man could sit by his telephone and read intelligently the messages being sent, and yet could talk through the telephone. Now I admit that neither telegraph, telephone, nor electric light wires are an ornament to the streets of any city. That I concede to start with. But the telephone is a necessity to the people, so is the electric light, if we expect to preserve good order, and have policemen kept reasonably safe (laughter). Therefore the electric light is a necessity in all well-ordered municipal governments where they have appointed these gentlemen to such risky offices (laughter). I do not except Chicago in this case. The Police Marshal of Baltimore, where we light up a district known as "The Meadow," writes over his own signature, that the electric light in this district is equivalent to an increase of 33⅓ per cent. of policemen, without saying anything about the protection which it affords the policemen. This same view is taken by the Chiefs of Police of New York and Philadelphia. I think I have disposed pretty effectually of the wrong the electric light is doing to the telephone; that is what I am trying to do.

A MEMBER: What is the distance or area of your line?

MR. MORRISON: I call to mind one district now, lines of telephone, trunk lines, carrying eighty-six wires. On the lower cross-arm are eight telephone wires and two electric light wires, both positive, working side by side, ten inches apart. We run out in one part of the city and come back in another. Now about the danger from electric light wires. We have had only one accident in the city of Baltimore since the installation of the Brush company. This was where a telephone man was trying to steal the right of way through Davis street. He strung his wire right among the Brush wires, and in hauling his No. 14 steel wire down over our wire, he cut through the insulation. There

must have been one of those grounds, spoken of by Prof. Gray, on that circuit. It knocked him over and treated him pretty roughly. That man had no business there, or he would not have got hurt. His explanation was, he "did not know the damned thing was loaded." This was equivalent to saying that he did not know they were running the electric light in the daytime. I maintain that a properly constructed electric light wire is not dangerous, any more than a properly constructed buzz-saw in a planing-mill. If you sit down on a buzz-saw you will be sorry for it, nor would the buzz-saw be any the worse for it (laughter). If you violate all the rules of common sense, go into an electric light place, and catch hold of the two poles of the machine, it is very likely that something will happen to you. A man in Buffalo was drunk and wanted to show that he knew all about the electric light business. He caught hold of the two posts of a 40-light machine. It killed him, the same as a buzz-saw would if fooled with.

In taking the electric light lines across a street you can run your telegraph and telephone wires up against them, and you will hurt no one if you do not chafe the insulation off. The weight of an electric light wire is so great that it requires additional precautions with it. You make stronger arms, and tie wires, and do everything necessary to give greater security to it. When you take a lot of No. 14 steel wire, or iron wire, it is light, and there is not the same care taken with it. But the telephone companies do not like the electric light wires above them.

The only dangerous case I ever heard of (and that did not hurt anybody) was in New York about three months ago. Now we all know how New York business is done. Lines are about half built, and there is always danger of their getting loose. That is the fault of the men who are trying to make dividends—trying to reap a crop before the wheat has sprouted. Their lines got foul, but did not burn up any fire-alarm boxes. It did not do a cent's worth of damage to the Telephone Exchange, but it did knock the inside out of the telephone in one of the engine houses. There were no "ten feet long" sparks, however. There was a half-column about it published in the New York papers. That did not fool the public. The trials and tribulations of the elec-

tric light companies never induced them to say a word about people being smothered with gas. Let us hear the rest of this business. Mr. Hibbard thinks the experience of telephone companies is, and he tries to show it, that there is danger in the too close proximity of the electric light. Then he goes along and gives a little advice. He says: "We have no desire to place an impediment in the way of our new neighbor." He is not such an old neighbor himself. He goes on to say: "I hold that it," the telephone company, "has the exclusive right to build its lines on the particular side of the street which it occupies, but it iscertainly discourteous and entirely illegal—" I do not think I will read any more of this letter. Do you suppose that if an illegal act was committed by an electric light company, the telephone company would let it live? I think not.

The electric light poles are no more unsightly than are the wires of the telegraph or telephone. If we are compelled to bury our wires underground, and go to that uncalled-for expense, then I say let all be treated exactly alike.

Mr. Morrison resumed the Chair.

Mr. Weeks: It seems to me we ought not to pass that matter over in this way. It seems to me, while we do not want to give up any of our rights, we do not propose to be bulldozed out of anything. We ought to listen with courtesy to complaints from whatever quarter. The telephone companies have a great many troubles, and Mr. Hibbard is probably from among a number who have made their complaints by reason of complaints made to them by their patrons. I would, therefore, listen with more patience to the complaints of such men as Mr. Hibbard.

The President: I do not know where I have shown any impatience. If I say anything at all I must say it in my own way. I meant to treat this subject fairly before the meeting. It is before you now, and my criticism against the exponent of the telephone business is also before you for criticism and action. You may take up the matter and suggest remedies, if remedies are needed. I know of no special remedy now except the more perfect construction of your own lines.

Mr. Hovey: It is in my way to hear a great many of these

complaints, and perhaps no one has been made more impatient by complaints founded upon ignorance of electrical facts than I have been. No one has found it his duty to hunt down false, malicious, and interested statements with regard to the danger and other difficulties which are said to grow out of electric lights more than I have. I never hunted one of these down that I did not find an interested motive at the end. Therefore, I can take up what the President says. The President was very careful to speak exclusively of what is said in that letter, and I heartily agree with him. Now, as a journalist, connected with electricity generally, of course I have no more regard for one branch of the electrical business than another; but I always find, in all matters, that the higher I go in the scale of men who are concerned in any business, the more generosity and courtesy I find. I want to relate one little incident which will show, I think, the issue in the mind of at least one man, a very important man, in the Bell Telephone matter. When I was President of the Electric Light Company in Boston, something over a year ago, with regard to putting the wires underground, I felt that the electric light interests alone were not particularly strong, and that it was possible that some other electrical interest might be disposed to throw us overboard. I went to headquarters and stated the case to Mr. Vail, the general manager of the Bell Telephone Company. Mr. Vail said to me: "The Electric Light and the Bell Telephone Company have come to stay, and they are going to stay; and you might say, we are either going to stand together or fall together, except that the latter is not the fact; we are going to stand together and help each other." I thought an expression of that kind, coming from the general manager of the Bell Telephone Company, was worth a great deal more than any flippant remark from any understrapper, and I think really that is the issue of the great telephone interest. But some man, who has some kink of his own, in some small city or town, may throw in a bombshell that really doesn't amount to anything at all.

Mr. Wadsworth: I want to say a word or two in regard to this matter. I am not now engaged immediately in the electric

light business, but it has been, in some years past, my fortune to have control of certain lines. I have heard more or less about the induction rot, and I agree with you in what you said about its being rot. I have been manager of an electric lighting company, and I have had the telephone people to fight; I have been connected with telephone people, and have had electric light people to fight. What you say about the case of induction from dynamo machines is perfectly true. I will go further than you went. Some years ago Professor Gray brought out a harmonic telephone and established a system of telegraphy between Columbus and Pittsburgh. Every telephone man in Pittsburgh and in Columbus raised a hue and cry about Professor Gray's instrument breaking up their telephone business. It has been my fortune to talk over these wires running side by side and parallel with Professor Gray's invention. Now it is much worse than anything that has been mentioned here, and yet the people of Columbus, of Pittsburgh, and of other cities, did not have any difficulty to carry on telephone business in their cities. The Pan Handle Road operated Professor Gray's system. The electric light of this country is giving the telephone people to understand they know that this induction business, which they prate so much about, is simply bosh and rubbish; and, after having used the telephone, any man of ordinary success can talk over this induction, and can get along with it. The quicker the telephone people take back seats, and recognize that the electric light has the same rights with them, the better. Now I have had a long and varied experience with induction in telegraph, telephone, and the electric light business, and four-fifths of this hue and cry about the destruction and induction from electric light, or any source, is simply rot. The greatest difficulty I have experienced with induction has been in the telegraph business with the quadruplex instrument. There you get an induction that is almost phenomenal. But when it comes to the electric light and telephone business, notwithstanding the induction, and the great Harmonic Duplex which is the worst thing I ever had to contend with, you can talk without any difficulty, and make yourself understood over the wires.

The President: The remedy for the evils of induction is a return wire for the telephone. That is a cure for it, and the return wire costs very little. The cost is in putting up the first wire. At the present time, those engaged in selling telegraph materials are striving, if possible, to get telegraph lines pretty cheap, about $80 a mile. That is not much to pay for getting rid of induction.

Mr. Sperry: I wish to say something regarding this. I have had some experience, inasmuch as the burning of one telephone instrument was attributed to our line. I searched very diligently for the cause, and could find no cross between the telephone wire and our line whatever. But, on looking carefully, I discovered that there was a cross between the telegraph line and our line and the telephone instrument. The telegraph line having a grounding and the telephone line also being grounded completed the circuit. This was near the terminal of a long line, which required a large distance of extension for battery. The telephone was burnt out by means of this. Now, I think it is the duty of every electric light man here to use all his knowledge in overcoming the idea that the public seem to have with regard to the extreme danger of electric light wires. While they are dangerous only under peculiar circumstances, they are far less dangerous than many things we have to contend with, and many things which we use every day, and which we consider not dangerous at all. The Chairman, in his remarks regarding this question, spoke of telephone lines coming down and cutting through the insulation of electric light wires. Now, I wish to say, that, in Chicago, there is a telephone wire which had cut through the insulation of an electric light wire. Even after the telephone wire had been grounded, it could not have hurt the telephone instrument, because here we are under rigid inspection, and many thanks for it. We are obliged to make our lines with one leg going to the ground, and I think it is the experience of every electric light man here, that nine-tenths of all the danger through the electric light line is from the fact that the wires become grounded in their ordinary use. Therefore, I would say that the great panacea for all this difficulty of the telephone and

telegraph lines would be the eradication of all the ground in our lines.

THE PRESIDENT: The Chair desires to state that it is almost impossible to give perfect insulation to any electric light plant that will absolutely carry out the idea which the gentleman suggests: that is, to have no escaping current from the line into the telephone or telegraph wire. The machine is set, say, on an iron bed. That iron bed is set on timbers, and the timbers are set on concrete as a general thing. That is about it, isn't it?

A MEMBER: Most generally.

THE PRESIDENT: So much for the machine. The lamps are placed upon poles or brackets. Between the iron frame of the lamp there is a portion of it which is charged and exposed to the action of the atmosphere. There is direct communication through dampness, which accumulates on the poles and the arm, or on whatever it is hung, thence to the ground, through which it partially escapes. With the present condition of hanging lamps, I do not know of any plan to obviate this difficulty. I would like to ask Professor Gray, if he bears me out in this?

PROFESSOR GRAY: It is very difficult to insulate a current of such high tension as arc lights carry. It may be grounded and not be known until a wire drops on it, because the electric light will still work with the metallic circuit, even after it is grounded, and when another ground is made at some other point the other wire will fall out, if the electric light wire is thoroughly insulated. It is not often the case that there is danger from the wire dropping on it. As I must go in a moment, I will say that there is a great deal of truth in what has been said in regard to induction, etc. However, I would agree to fix up what I call a bumblebee's nest. It is very difficult to talk where there is induction. On Broadway, in New York, which is the noisiest street in the world, you are compelled to raise your voice to a high pitch in order to be heard by the person you are addressing. It is just so with the telephone. If there is a great deal of induction from other wires, you must raise your voice to be heard. You can do it in most cases, I admit; but, after all that can be said on the subject of induction, the difficulty is with

the telephones. Now, these two enterprises, as has been remarked, have come to stay. The telephone is one of the things that is a necessity. So is the electric light. The interests of gentlemen who are interested in telephones and electric lights are common. That which is good for the one is good for the other, because you are furnishing the same customers. Your electric light customers are using the telephone, and *vice versa*. The thing we must do is to so arrange the circuits of both systems, I care not whether overhead or underground, that there will be the least possible interference to both. In that way there will be the most efficient service to the public. I would also suggest this. Nothing is perfected in a day. It has taken the world a long time to understand electric science in its present status, and it will take a still longer time to become perfect in all these things. Every year will show progress. We will have more electric light plants, more telephone stations, and, at the same time, we will have a station for taking observations. Let there be a competent man, whose business it is to trace any unusual phenomena to the cause and know the facts. Facts are what we want. We do not want somebody's theory about it; we want to know the facts as far as possible. When we put these together, we can ascertain the cause, and how to avoid trouble. I suggest that we form some kind of an organization. There are gentlemen here from all parts of the United States. Let us have some organized plan to make observations. It will not only be a help to the growth of your own business and your own interests, but a contribution to science that will be valuable for all time. There is not a class of people in the world who have a better chance for observation, and can furnish so much in the way of getting new facts in relation to electric science, than the men who are in the electric light business, telephone business, telegraph business; in all departments of Electricity. They leave far behind the Professors who acknowledge they have to come to us now to get their facts. They are the only teachers who can teach those who are in practical work, who are delving in these things, and making observations all the time. We can, by proper observation, be a great school, and, at the same time, carry on an impor-

tant branch of business. I simply throw this out as a suggestion, Mr. President, and you can get it into some organized shape. (Applause.)

Mr. Bowen moved that when this Convention adjourns this afternoon it adjourn until to-morrow morning at ten o'clock, which motion was seconded.

A member: Can't we have an evening session?

The President: There are gentlemen here from all over the country, who cannot stay here long. Besides, in the way we are progressing, we will not get half through the list.

Professor Gray: Allow me to make a suggestion. Instead of having a general session, would it not be well to spend the time in committee work? We can do a great deal more in some organized way to present topics to the Convention, and we will get through a great deal more business in the same length of time. It occurred to me you might in that way do more by not having a regular evening session.

The President: That is a good suggestion.

A member offered as an amendment to Mr. Bowen's motion that when the Convention adjourns it adjourn to meet this evening at half-past seven o'clock.

The amendment was carried, and the motion as amended adopted.

The President: The gentlemen will remain in their seats a moment. Mr. Bowen is preparing a motion to have a committee appointed, to which this question, which has just been discussed, shall be referred for further light on the subject.

Mr. Bowen moved that a committee of three be appointed by the Chair, whose duty it shall be to submit this question in as concise a form as possible, with such suggestions as they have to make, to the Convention to-morrow morning, or this evening.

The motion was adopted.

The Chairman appointed as such committee Professor Gray, Mr. Bowen, and Mr. Curtis.

Mr. Brown: Professor Gray lives in one of the suburbs of Chicago, and I understand he has gone home.

The President: I asked him to remain until evening, and he said he would probably do so.

A member: He may be back again.

The President: I will appoint Mr. Brown on that committee as alternate for Mr. Gray, to act with him if here, and for him if absent. I would like to have an intelligent report on the subject. The thing to be done is to take up the complaints in Mr. Hibbard's letter, and such other complaints as we may have before us, and treat them as their importance demands. What we want to get at is a remedy. The next subject on our list is "Electric Light by Water Power"—Mr. George B. Fletcher, of Dixon, Illinois.

Mr. Fletcher: It is more for the purpose of hearing the theory of other members of the profession that I arise. I know myself about my own experience. I have only a small plant.

The President: We would like to know what kind of machinery you use? How much less it costs to make light by it than it would if you used the steam engine? What success you meet with? How steady your power is? That will give you a hint.

Mr. Fletcher: I do not know about the cost of steam power. I know about the cost of running my own plant. It costs me about $2.50 a month to light a ten-lamp circuit, including the interest on the investment.

The President: What do you pay the engineer?

Mr. Fletcher: The Lord is the engineer.

The President: You mean by that you do not have any engineer?

Mr. Fletcher: No, sir; we start the machine and let it go. Then it takes care of itself.

The President: That is, you put up the gate and let the water run on it.

A member: You have a turbine water wheel?

Mr. Fletcher: I have. The wheel was bought seventeen years ago, and cost $1250. We are bothered sometimes about high water. This occurred only once, last January. As the river rises it gives back-water. During that time I had to cut

out about half my lights. I selected customers that had gas in their store, and they lit the gas.

A MEMBER: What kind of a governor have you on your machine?

MR. FLETCHER: I have no governor whatever. I took it off. I had a Rockford governor.

THE PRESIDENT: How many lights are you running?

MR. FLETCHER: Seventeen lights in stores, and three lamps on the streets. I get my carbons for $15 a thousand.

THE PRESIDENT: Where do you buy them?

MR. FLETCHER: At the Buffalo Electric Works. (Laughter.)

THE PRESIDENT: That is the best information we have struck to-night.

A MEMBER: Are your lights steady?

MR. FLETCHER: I claim we have the best lights. (Laughter.) They are called semi-carbons. They are guaranteed to burn six hours. They take less power, burn later, and light easier and better than any other kind.

THE PRESIDENT: How long are they, and of what diameter?

MR. FLETCHER: They are copper coated, 12 inches long, $\frac{7}{16}$ diameter.

A MEMBER: What satisfaction do they give your customers?

MR. FLETCHER: To the customers it doesn't make much difference. They can't tell.

THE PRESIDENT: You use $\frac{7}{16}$ 12 inch copper-coated carbons.

MR. FLETCHER: Yes, sir.

THE PRESIDENT: They ought to burn six hours. What dynamos are you using?

MR. FLETCHER: A thirty-light Van Derpoele dynamo.

THE PRESIDENT: It may be that is better than the Brush.

MR. FLETCHER: Yes, sir. I will further state, speaking of carbons, I have tried them all. I have had every make. I do not use them in winter, when it is required to run more than six hours.

THE PRESIDENT: Then you use one a half-inch longer?

MR. FLETCHER: I use the same an inch longer.

THE PRESIDENT: Do you burn up the 12 inches of carbon in six hours?

MR. FLETCHER: Yes; as a general rule you can use it from top to bottom.

THE PRESIDENT: Then you use 9 inches in six hours. This leaves about one-third. What force do you employ in the works? You do not use an engineer, but you must have some person to handle it?

MR. FLETCHER: I run a planing-mill. It costs me only $15 a month for the care of lamps and attendance on the machine. The attendant is one of my operators, and he has nothing else to do but to sit in the place, and when the time comes to shut down.

A MEMBER: I would like to ask the gentleman, whether he has any interest in the company manufacturing that carbon?

MR. FLETCHER: No, sir. (Laughter.) I am not here to advocate carbons, but I was requested to state what they are and I did so.

A MEMBER: How long have you been running these lights in that way?

MR. FLETCHER: Since the 12th of November, 1883.

THE PRESIDENT: Have you always bought carbons at $15?

MR. FLETCHER: No, sir. I paid $6.50 a hundred for the first lot.

A MEMBER: Are these just as good as the first?

MR. FLETCHER: They are better. I would like to hear other gentlemen, if they can make as good a showing as I do. (Laughter.)

MR. RANDOLPH: Mr. President, I want to state, in the start, that the Forest City Electric Light Company put in a 20-light machine, which we operated with a 42-inch Leffel wheel with a 6-foot head. That gave us about 20 horse-power. We found in operating our lights that we had a great deal of trouble; that is, the lights would not always be steady. The only way we could account for it was, that when the mills on the race shut down, there would be more power than we wanted. We also found, after a certain hour, when others were shut down we were going faster. We then put a governor on our water-wheel, and when a test was made we found that our lights ran as steadily

and satisfactorily as arc lights will run. We paid $1 per day for the wheel, twenty-six days to the month. Outside of that the only help we had was one man, who in the daytime put carbon in his lamps fully half a mile from where the power was located, and then in the evening, after he started up, he would go around his circuit two or three times and see that everything was all right. The remainder of the time he would be where the machine was located. I think, when you can get steady water-power and not be troubled with back water, it is the cheapest and best mode of running the electric light that I know of, and we have had experience with both water and steam. After running some four months we increased our plant from twenty to sixty lights and then put in a 40-light machine. We could not get another wheel, and the consequence was we had to move. At the end of the four months we declared a dividend of seven per cent. on the 20-light machine.

A MEMBER: How much capital?

MR. RANDOLPH: Our capital stock was $10,000, and the plant cost us $5000. We paid seven per cent. on $5000 for four months. There was a little surplus besides. We then put in a 40-light machine and put on steam power. Where you can get water-power it is the cheapest mode of running an electric light and the most satisfactory. Our governor worked the water wheel perfectly, although the depth of water varied sometimes from six and a half to seven feet, and then would fall as low as four feet. This made no difference. It was not so much trouble as steam.

A MEMBER: I would like to ask what governor you are using?

MR. RANDOLPH: It is manufactured at Rockford. The name does not come to me just now, but I can find out and let you know. We tried two or three others before we tried that. It is the best governor we could get.

THE PRESIDENT: The Chair will appoint a committee to report to this Convention the cost of a 100-light plant run by water. That will give us something to go on, based on the experiments which have already been made. I will appoint on that committee Mr. Randolph, of Rockford, Illinois, Mr. Fletcher,

of Dixon, Illinois, and one other gentleman who is familiar with machinery, Mr. Jacobs.

A member desired to have a committee appointed to make some calculation in reference to steam.

THE PRESIDENT: We have not come to that business yet, but it is a good idea.

A MEMBER: A 100-light plant with steam, giving the pounds of coal instead of the price.

The Chair then appointed S. S. Thatcher, J. B. Fleisheim, and W. A. Hammett.

MR. LEWIS: Do you think it prudent to appoint a committee to make a statement here of the exact cost of a plant and the exact cost of operating one? There are companies that are meeting with considerable opposition in collecting their rental. The consumers think they are making 100 per cent. on the investment, and it seems to me that it is for the interest of all those who are operating electric light plants to keep the cost a secret. (Applause.) It strikes me that way. You cannot get the cost of manufacturing gas. They will tell you they are losing money.

A MEMBER: I think the best way of convincing renters of electric light is to show them the figures.

THE PRESIDENT: I would say to the gentlemen, this action is upon the idea that this Convention is held with open doors for the purpose of securing information for our own government and to show to the general public we do not charge an excessive price for our product. As manager of the Brush Electric Light Company of Baltimore I am familiar with these details, and I do not fear scrutiny into matters of management and charges. These matters, however, are in the hands of the Convention, and if any steps are taken here that meet with a protest, then they become the property of the Convention to be disposed of as it sees fit. If this report is to be made to the Convention with closed doors, all right, but we ought to have the information.

A MEMBER: I think the report should be made with closed doors. If the whole proceedings of this Convention are to be published, people would say at once, we ought to furnish electric

light at $2.50 a month according to the figures of our friend from Dixon.

THE PRESIDENT: They will have to go to Dixon to get it.

A MEMBER: We want this gentleman to come to Racine if he can buy carbons for $15 a thousand and employ an engineer at $15 a month.

MR. BROWN: We will. The Lord furnishes the engineer. You can't bring the Lord to Chicago!

A MEMBER: He seems to be nearer Dixon than Racine. It seems to me, Mr. Chairman, that it is entirely improper to make the expense of operating and building electric light plants public. I seriously object to that as a member of this Convention. There is no business man in this Convention in the city of Chicago, nor in the United States, who will publish the expense of the article he is manufacturing. It is unwise. People nowadays think that if the manufacturer is making over five per cent. profit on the capital invested, he has a bonanza. It makes no difference what that article may be. Five per cent., the farmers say, is sufficient, and the consumer says five per cent. is sufficient and everybody else that consumes electric light will say two per cent. is enough.

MR. BALDWIN: It seems to me, whatever may be the propriety or policy of publishing such statements, the work assigned to this committee is surrounded with so many difficulties and embarrassments as to make it impracticable to bring in such a report as will be valuable to any of us. In Baltimore you may pay $3.00 a ton for coal, and my friend in Kansas City may pay $1.50 for coal; we cannot compare notes. His plant will be operated much cheaper than ours. If this gentleman buys an old saw-mill out in the country and runs it as a saw-mill at one end, and an electric-light factory at the other, it is not an electric plant in the ordinary acceptation of the term. It is not such a plant as would be put up in the city of Chicago. You can start anything that I know of, an electric plant or any other kind of machinery by water-power, but there is no water-power in Boston, no water-power in Baltimore, none in New York, none in Philadelphia and none in Chicago. I think that if I lived in the

country by the side of a stream and started an electric light plant by utilizing this water-power at night and running my saw-mill in the daytime, I could make money out of it by selling my light at a very low price. Probably you would be compelled to sell it at a very low price in order to introduce it into a small place of that kind. Perhaps it could not be done in any other way. But it does seem to me the difference in the location of these different organizations is so great that you cannot make this report in such a way as to be of any value to us. In Pittsburgh and in Wellsburg, West Virginia, they run their engines by natural gas. The Lord makes the gas as the Lord furnishes this man with an engineer. He sends it down through wells. The people tap these wells and draw the gas out, set it on fire and run their machinery that way. You can't do that in Baltimore. It seems to me if we spend our time in that direction we will not accomplish a great deal. I put the case this way in addition to the objection made by the gentleman on the other side of the house, which may or may not have any valid force. It is true most people do not publish their business. So far as I am concerned I have no secrets. I do not get my carbons for $15 a thousand, and for that reason I cannot make light as cheap as this gentleman.

THE PRESIDENT: In Rochester they are able to sell light at forty-five cents, while in Baltimore we charge seventy cents, and cannot get rich at that price. Rochester uses water-power, Baltimore steam-power. There are on file in my office to-day, in Baltimore, applications from two citizens, in which they ask for the employment of water-power. There can be no injury done in endeavoring to find out the relative cost of steam-power and water-power. I think it quite an important matter. An objection has been made to the appointing of this committee. Shall that objection be sustained? If sustained, the appointment of the committee is revoked.

On the question being put to the Convention, the objection made was sustained, and therefore the appointment of the committee was anulled.

On motion, the Convention adjourned, to meet at 7.30 o'clock in the evening.

EVENING SESSION.

The Convention was called to order by the President at 8 o'clock on the evening of February 25th.

THE PRESIDENT asked Mr. Brown whether he was ready to report from the Committee on Induction, and Mr. Brown replied, "He would report the following morning."

THE PRESIDENT: I have just been informed by the chairman of the committee who were to act in conjunction with Professor Gray, that, while they have formulated a report, they desire more time to consult Mr. Gray, he being absent from the city; therefore, we will take up the regular order. We will now take up the question of "The Best Modes of Connecting Dynamos with Power." The Chair is ready to hear from any of the gentlemen who desire to speak on this subject.

MR. BROWN desired to hear from Mr. Stewart. But Mr. Stewart was not present.

MR. IDE: I will give a little of my experience. We have eight twenty-light machines, with two engines; we have two driving-wheels on each engine; we belt directly on the machine, running one belt over the other, with a nine-inch pulley and an eight-inch belt. On the top of the first machine is a second, further back, straddling the first; it occupies very little space, and makes it very compact. We have been operating it in that way for two years, and it gives great satisfaction and excellent results. One important matter in belting up is, to make it reliable without much friction or too much slipping of the belts. I would like to hear from those experienced in friction-clutches. I think it is desirable to have machines that can be stopped and started. The only objection we have to the Jenney machine is, that we must stop the engine to get a belt out of the way; it takes some time, a minute or two, to do it; but, if there were a friction-clutch arrangement, when the machine is out of order it could be stopped. There is another thing we have that is very convenient. While running four machines, we use only three; we have four running with binding-posts all running to the switch-board from each

machine. In case a machine burns an armature on short circuit we can cut another in without stopping or the lights going down. It requires only two or three seconds to do it, and I think it is a very convenient arrangement. I will state we are running four twenty-light machines in a circuit. I would like to hear the method of getting up the machine and counter-shaft discussed. I saw an arrangement in Philadelphia, which I think was a very good one, connecting the dynamos. They used counter-shafts, however.

MR. STEWART: There are many different and many good methods. It depends much upon circumstances.

THE PRESIDENT: Tell us what in your opinion is the best method.

MR. STEWART: Where you can belt directly from an engine and can get good friction-clutch pulleys, it is a very good thing, but I have not had very good luck. There may be some very good ones.

MR. IDE: I have always been afraid of them. If there are any good ones, I would like to hear from them.

MR. STEWART: We have some pulleys that work very well. I like belting directly from the engine to the counter-shaft.

THE PRESIDENT: That means from the engine to each dynamo, or from the engine to two dynamos.

MR. STEWART: You can arrange your dynamos on sliding carriages and arrange your belts without much difficulty. That has been the most successful plant in my experience.

MR. WEEKS: My experience has been also the same. When I first took charge of the plant in Kansas City we had not only a shaft but a counter-shaft. We have since abandoned wholly the counter-shaft, with a saving of twenty-five per cent. in power. We are planning now to abandon the shaft, and by so doing we expect to save probably about ten or fifteen per cent. of our power. I think that the advantages of belting directly from the dynamo to the engine-shaft are obvious to every one. I would like to hear from some one who has had some experience with dynamos on the same shaft with the engine, without the intervention of any belt whatever. I have heard that machines

have been successfully run that way. I would like some information about that.

Mr. Sperry: While we are considering the belting question, I would like to say a word. I find in my experience that a perpendicular belt should be avoided if possible. Then another thing. In the construction of small engines where a high rate of speed is required for the pulley, I find it is a disadvantage to use too big or too thick a belt. The centrifugal action of the belt tends to throw the same away from the pulley and detracts to a large extent from its driving qualities. This is, of course, counteracted by the weight of the belt on a long stretch, but where you have a short stretch between the engine and dynamo, and a high rate of speed, you will find the centrifugal action of the belt will throw it away from the pulley and the adhering qualities of the belt are less.

Mr. Badger: I would like to have Mr. Weeks tell his experience in running dynamos from the shaft. I would like to hear whether he has had any experience with clutches, and his mode of operating them. We have been intending to put a shaft in our plant, and we have investigated the shaft and friction-pulley question to quite an extent, and I would like to get the expression of Mr. Weeks on that subject.

The President: I understand the question of Mr. Weeks to be: Have you ever used gearing instead of belting? That is the question you desired answered, is it not?

Mr. Weeks: Yes. For instance, using a belt and having one counter-shaft bolted to the floor with a driving engine with a friction-clutch pulley on that shaft to economize room.

The President: I can tell you something about that, perhaps. When the New York company was first started they used a single pulley on the dynamo. They also used shafts and counter-shafts. After going along for about a year they abandoned all that and adopted a new inside gear-wheel. You understand what that means without explanation. All the belting they have is from the main driving shaft to the machines. This shaft is driven from a pit engine-room by gearing the balance-wheel of the engine on to the main shaft. In Philadelphia they started

with 16 engines and 16 dynamos, an engine for each dynamo, and belted directly from the engine to the dynamo. They carried that out until they had the opportunity of making comparisons with other companies which pursued a different course. Then they abandoned the small engines and put in two engines of 250-horse power each, driving to a main shaft and belting from the main shaft down to the machines. They got that idea from the Baltimore station. When we started in Baltimore we paid sixteen thousand dollars for a lineshaft, 96 feet long, $3\frac{1}{2}$ at one end and $4\frac{1}{2}$ at the other, equipped with friction-clutch pulleys enough to drive 22 machines, large and small.

We had the best pulleys Poole & Hunt could make, and they had full knowledge of where they were going and into what service. We run them with the Frisbie clutch for two months, at the risk of the life of every man who attended to that line shaft. On one occasion a chunk of iron flew out of the face of this clutch-pulley weighing forty-six pounds. We had pulleys seven feet in diameter, and these were running three hundred revolutions a minute when that piece of iron flew out. After running these clutch-pulleys eleven months, we had found no solution of the difficulty except to go back to the old-fashioned plan—a broad driving-pulley on the shaft, with tight and loose pulleys on the dynamo. This Frisbie friction-clutch pulley, supposed to be the best clutch-pulley made, is not good for electric light service—at least such was our experience. The experience of the past four years has taught me that the safe and economical plan, that which saves your belting, saves your machinery, gives you a cool shaft, lets you sleep at night when you go home, is the old-fashioned tight and loose pulley.

Now, the question of large engines and small ones comes in at this point. The Philadelphia company does not buy any more small engines. It has just put in a large Corliss engine, and drives the same as we in Baltimore. Compare the cost of running six engines of 100-horse power each with that of one engine of 600-horse power, and you will find the difference between running a large engine and small engines.

Mr. Yarborough: Some of our Board conceived the idea that

we can put small engines in our works at a much less cost, and a much greater saving of power, than the one we now have, which is 120-horse power. We want all the information on that point we can get; whether to discard the 120-horse power engine and our line of shafting and pulleys, and put in small engines, or stick to our present engine.

MR. MCDONALD, of Fort Wayne: From my experience, I am decidedly in favor of the small engines. At Peru, in this State, over a year and a half ago, a plant for something like 165 lights, with two large engines and two large boilers, was put in. After running a short time, we found we could not make money running that way; so we put in small engines. We had no difficulty making steam. The company has declared a good dividend. We have also had the friction-clutch pulleys that you referred to, and they were all friction. Everything about them was friction so long as they stayed there. About the same time there was a plant put in at Logansport, with a 150-horse power Corliss engine. They are driving 110 lights. Their friction-clutch pulleys would not work. They took them off and put on the ordinary pulleys running to the counter-shaft. At Danville, we are running two ice engines belting directly with one machine behind the other. We have four pulleys and eight machines. The reports we get show more loss belting that way than belting from a counter-shaft. The same is true at Fort Wayne. We started there with one large engine, which we still have in use, belting from a counter-shaft. In our increase there, we have put in small engines. Another advantage I claim for small engines running directly is, that there is no piece of machinery so perfect but that it is liable to accident; and if your entire plant is driven by one engine and an accident occurs, all your lights are out. If you are driving from a large number of small engines, all are not likely to get out of order at the same time. One portion of your lights may go out, but, as a rule, if you have plenty of power you can stretch it out on the dynamos and give them light. This is my experience. We are decidedly in favor of the small engines, both as to economy and cleanliness in every respect.

A MEMBER: I would like to ask Mr. McDonald if putting in

the small engines has made any difference?—I understand you are running the large engine and counter-shaft and the small engines belting directly. What is the difference in fuel?

MR. McDONALD: The small engines developed more power to a pound of coal, considerably more, than a large engine does; but at Danville, where we are running two small engines belting directly with about the same number of lights, we run with about one-eighth less fuel than at Logansport with a Corliss engine running from a counter-shaft.

THE PRESIDENT: How many pounds of coal and what kind of coal are required to make one-horse power for steam?

MR. McDONALD: We use coal at about $1.50 a ton. It takes six pounds of that for a horse-power. We use the ordinary boiler, but it is set differently. The boiler is set on a return flue passing under the back through the boiler and over the top of the boiler with a stack at the rear instead of the front. That is an idea connected with our company. I do not know whether it is worth anything or not.

THE PRESIDENT: Do you use bituminous slack coal six pounds per horse-power per hour? What does the coal cost?

MR. McDONALD: $1.60.

THE PRESIDENT: What does good coal cost?

MR. McDONALD: You can buy ordinary soft coal, probably the nut, at $2.25, and lump $2.75 to $2.95.

THE PRESIDENT: That is what you call steamboat coal. Where is that place?

MR. McDONALD: Fort Wayne.

THE PRESIDENT: Now coal costs us a little more than that. We use a return tubular boiler, 12 feet long. We are now putting in boilers 16 feet long, and in the short boilers we are burning this kind of coal. We burn in our works anthracite screenings, the dust which is the refuse at the mines. We buy it at 10 cents a ton, and it costs us $2 to haul it to Baltimore, which stands us $2.10. We buy some stuff from the coal yard at about $1.50 a ton. Three tons of anthracite screenings are mixed with one ton of slack bituminous coal. This is the sort of fuel we use. Three and a half pounds of that trash per horse-power per hour,

are used. Our boilers are shorter but of the same diameter as yours. They are set with the Jarvis furnace.

A MEMBER: What engines do you use, and what is the style of your furnace?

THE PRESIDENT: We are using the Buckeye engine, and the ordinary return tubular boiler with the Jarvis furnace. The boiler is 6 feet in diameter, 12 feet long, with 119 three-inch tubes.

A MEMBER: May I inquire whether those small engines at Philadelphia are automatic engines or not?

THE PRESIDENT: Yes, sir, the Porter & Allen engines.

MR. WEEKS: Unless my memory fails me, Mr. Law, the superintendent of the company in Philadelphia, told me last fall that they were pretty well satisfied with the 250-horse power Corliss engines for large work, but they thought that hereafter it would be better to put in small engines of the Porter & Allen make. It is possible that I am mistaken, but that has been my recollection all along. If you have seen him since you know whether it is so or not.

THE PRESIDENT: Yes, my knowledge of the Philadelphia Company is just as I have given it to you. They first used the Porter & Allen engine, and then put in a large engine. Since then I have not heard from them, but I will call up a gentleman who has just come into the room. Mr. Baldwin, will you give the gentleman the information you received from the agent of the Philadelphia Company in relation to small and large engines?

MR. BALDWIN: I will say that I am not possessed of any specific information that would justify my making a statement other than the fact that when they organized their company they organized with a small engine. My first visit to that station was before we got fairly under way, and I found they had six forty-light Brush dynamos running or ready to run; I think it was six. They had attached a forty-five horse-power Porter & Allen engine to each machine, and the engine was running like the sheriff was after it. (Laughter.) I met Mr. Porter there. He and I sat together—I admire him very much. They did look pretty then, as pretty as a picture. They were running that way a considerable time, but when they increased their work, and

changed their station, and put it into its present form, they introduced a pair of Corliss engines, I think 250-horse power, each coupled together, and they do most of their work with that pair of engines, still retaining in place some of these smaller engines. I think they regarded their method as an expensive one—a very expensive one I thought at the time. While it had its advantages, it had very grave disadvantages for a large station. It will do for a small station, but not for a large one. To run their whole works in that way was, to my mind, a very expensive method. I was not willing to adopt it, and we did not go to that extreme, although our smallest engine was 125-horse power. I think they have practically abandoned that system.

THE PRESIDENT: The reason I asked an explanation is that Mr. Weeks said he had some conversation with Mr. Law and he expressed the idea that they preferred the small engines.

MR. SPERRY: Last fall I spent a forenoon with Mr. Law, and derived a greal deal of information from him. He took me through his boiler-room and showed me his peculiar arrangement. He replaced all his boilers except two with Babcock & Wilcox boilers. They are long boilers instead of short ones, and are smaller in diameter, each one containing two flues. He expressed himself regarding the change of engines. I think four of the small ones and two large Corliss engines, from which the plant was driven at that time last fall, still remained. He said that something was saved at night when all the plants were in operation, but in the daytime, when only a very few of the machines were working, it cost more, and I think it would. But he made no statement with regard to the adoption of engines for future enlargement, though one point I noticed; the dynamos were placed on the upper floor and the counter-shaft was placed down even with the main floor of the room, there being no basement, I believe. This he thought was better, owing to the fact which has been developed here this afternoon. He said the dynamos all seemed to be grounded more or less; that is, there were certain leaks through the frame of the machine. When they were set on timbers placed immediately on concrete or a stone foundation, as the case might be, these timbers became

saturated with oil and became more or less conductors, and the current leaked that way. His last idea was to place them on the upper floor, which is certainly a capital one.

MR. DONALDSON: I was very much interested in the question of fuel. It is a serious one with us. We pay $6 a ton for soft coal, and I will admit frankly I tried the screenings, but it was not altogether a success.

THE PRESIDENT: Did you use the Jarvis furnace?

MR. DONALDSON: No, sir, I did not, and that is what I want to get posted on. The question of fuel looms up seriously against the profits of the institution, and in considering it, a question has come up here which I think has not been deliberated upon quite as extensively as it should be. We have been using three engines, 250-horse power each, and one 125-horse power. I will say that our experience has been very much in favor of large engines. Our large engine is a Buckeye, the same as you say your small ones are, set in a line. My own experience is decidedly in favor of large engines. Now I want to know particularly if any one is using a large Corliss engine connecting directly with a machine-shaft by a jack-shaft and cogs, using no intermediate belting at all. We are about to build a new station, and we are thinking of putting in an engine of that style, and I would like to have the experience of any that have used such, or an opinion on using an engine of that character.

THE PRESIDENT: I do not think there is anything of that kind extensively used in the country except at the Elizabeth station in New York. They attach the main shaft, the gearing and belt from that over to a jack-shaft or counter-shaft. They think it a success.

A MEMBER: I would ask the gentleman what he has to pay for screenings where he pays $6 for coal?

MR. DONALDSON: I have been offered screenings at $1 a ton.

A MEMBER: If you put in the Jarvis setting you can save fifty per cent. on your fuel.

THE PRESIDENT: More than that.

A MEMBER: The same number of pounds of screenings with a

Jarvis setting will make the same amount of steam as steam-coal in the ordinary furnace.

MR. DONALDSON: You understand screenings is considered a total loss by these coal yards. It is simply dust and dirt.

THE PRESIDENT: That is what it is, dust from anthracite coal.

A MEMBER: We desire to know the expense of the Jarvis furnace.

THE PRESIDENT: I think the cost is about $175 for a Jarvis setting.

A MEMBER: We find it saves about one-third in the amount of fuel used over ordinary settings.

A MEMBER: Can an old boiler be refitted?

THE PRESIDENT: Yes, sir.

MR. BALDWIN: The way we do when we make a contract for a boiler as we do now for setting boilers, we get, perhaps, three or four specifications from half a dozen boilermakers and tell them we want the Jarvis setting, and they make the rest. They get the price from the Jarvis people.

THE PRESIDENT: The Jarvis furnace is a part of the specifications on which the boilermakers bid.

A MEMBER: Do I understand you burn soft coal screenings?

THE PRESIDENT: We use soft coal screenings, one ton to four tons of anthracite dust. The soft coal we use to make the anthracite coke a little so it will not fall through the grate bars.

A MEMBER: You will find firemen do not like to use screenings.

THE PRESIDENT: Correct. We discharged three firemen on account of that. We had three or four firemen that could not fire screenings until they were discharged and hired over again.

A MEMBER: Who has had any experience in smoke burners?

THE PRESIDENT: There seems to be no gentleman to answer that question. We have not as much use for it in our country as you have out here where you burn soft coal mainly. The Jarvis furnace seems to burn the smoke up except in the first starting of the fire when we have a little of it. You would not know there was any fire under our flue when we are fairly under way.

MR. HAMMETT: In reference to the Jarvis furnace, where they get the great gain is in setting the boiler further up from the ground, which gives them a chance to burn the gases before they pass up the chimney, and then in forming a plain bed back from the wall. They make their form of setting so that it gives a better chance to sweep around through the flues, than it does in the ordinary setting. Most of the boilers force them down to the grate. The front is made very low. I know through the East we used to set boilers invariably from 27 to 30 inches from the grate. Any one can get a much better result out of it through this section, following that rather than setting boilers close to the grate in the usual way. That is where the great benefit of the Jarvis comes in.

MR. WEEKS: I think the gentleman is correct. We have our boiler set high from the grate, and, without the Jarvis setting, we obtain very much the result others have in burning screenings.

A MEMBER: I speak from experience both as to the Jarvis setting and other settings. I have handled them both and as an engineer know what they are practically.

A MEMBER: You can mix these hard coal screenings with about one-third of coal. That forces up your fire. If you take the screenings alone, they back down on the grate and it is impossible to get air through; but put enough soft coal in with them it swells up as it is burned and keeps the fire open all the time, as this gas passing off wants more chance to burn than with hard coal.

MR. DONALDSON: I am interested in this question. I want to know if you can get along with the natural draft in burning screenings, or do you have to use an artificial one?

A MEMBER: You can get along with a natural draft if it is ordinarily good. A skilful fireman is better than any furnace you can put in. I will take any furnace and show equal results with the Jarvis; if the fireman is careful when he first fires, and opens the door to let extra air in to mix with the gases, he will get as good results. Firemen are too lazy to look after this properly. That is the reason Jarvis has been able to get better

results. It does not require as much air as it does with soft coal, and not having a register for admitting the air, along towards the last, and before you fire again, too much air has been admitted to properly burn what gas is coming off.

MR. DONALDSON: You take natural draft, and if not strong enough what kind of artificial draft would you recommend?

A MEMBER: Put a blower on. I put blowers in use when there is not enough draft to draw to advantage.

THE PRESIDENT: When that is done, Mr. Donaldson, you do it at the expense of fuel.

MR. DONALDSON: I tried that until I am satisfied. I put in a blower with a draft strong enough almost to blow the stuff off the grate, and still we could not get as much heat from four boilers as from one burning good coal. That is our experience, and our boilers are 18 inches from the grate. It is not a great distance, but not particularly short. We tried natural draft, which would not do at all, because the stuff lay flat on the grate; we then tried a moderate sized blower, which gave us a nice little draft but would not make steam; we then tried a big blower, which gave an enormous draft, burned lots of screenings, and from four boilers we had not as much steam as from one with good coal.

MR. VAN DEPOELE (who was loudly applauded on taking the floor): In regard to the admission of electrical currents to be used in motor power, it certainly is within the experimental stage yet, but still it is not at the beginning, but rather at the end. A great many facts have been developed in the last two years, in this country and abroad, which have shown that electricity can be used as the means for transmitting power, much more economically than any motor transmission of to-day. Under favorable circumstances you can get a return of 70 per cent. and under less favorable circumstances you can get 50 per cent. any time. In a city like Chicago, and a great many other places, where there are so many small shops which require two, three, four or five horse-power, and so on, a great many printing offices and the like, needing cheap power, it would certainly be a great benefit to them. Now for four or five horse-power there must

be an engineer, a boiler, and engine and fuel. And the attendance for a five-horse power will cost surely $3.00 a day at least. If they could they would get the electrical power to do the same amount of work for $2.00 or $3.00, as it is clean and would in fact be a saving in every way. It certainly would be a big advertisement to this electric motor if these experiments have gone so far and demonstrated beyond a doubt that this can be done. All that is necessary at present is to go to work and apply the power to some certain practical purpose, and it will be demonstrated that it is a success.

A MEMBER: Has any method been invented to govern the electric motor?

MR. VAN DEPOELE: That has been done almost better than any steam engine can be. That is done in such a shape it does not require any mechanical governor whatsoever. But really the action of the motor itself comes to be its own governor, so that whether it is fully loaded or running empty, there is going to be very little more difference than what there would be in an engine. In fact not as much difference. That is the present stage of electric motors.

A MEMBER: Will you please state your experience in regard to the loss of power in transmission? That is in transmitting ten-horse power over a circuit of one mile. About the percentage you get back in the motor, the per cent. that is expended in driving the dynamo, and what per cent. you would get back in the other end of the motor.

MR. VAN DEPOELE: Whether one mile or ten miles it is always the same, provided you have no leaks. You certainly must be more careful to have the lines well insulated; then with proper proportions between the generator and motor we can get a return of fifty to seventy per cent., never below fifty. We can get more than fifty if things are favorably circumstanced, we can get seventy-five. This I have tested, and stand by it.

MR. DONALDSON: I want to know if you can run a number of motors from one dynamo, or do you have to have a dynamo for each motor?

MR. VAN DEPOELE: You can run any number of motors.

One does not interfere with the other, provided the generator at the other end is made automatic, which it certainly can be. That belongs to a system just as well as when ten or twenty motors are running, using their relative power. It takes so much more current from the generator every time the motor is doing work. It takes less current from the generator, less power necessary to keep it in motion.

MR. WEEKS: Are you at liberty to state to the Convention about the recent invention of Mr. Henry on street railroad?

MR. VAN DEPOELE: I do not know whether there is any invention; simply an application. Mr. Henry proposes to carry a current by means of a proper tube, and a steel wire drawn through the tube. The power will be taken right from that conductor. That seems to be the idea of Mr. Henry.

MR. SPERRY: I do not know that I can give the Convention any information, I am sure, but I agree with the first speaker, that the trouble with the motor to-day is want of application. I think, if some one would go to any electrician or any of our companies, and say "we must have a motor, put a motor in our place, we will pay money for it," I think we would get one, but I think that the success would be a matter of very much question. The matter of supplementing the stations, especially in large cities, in the summer, by motors which will run an evening, is a question which has occupied important attention. It certainly is very possible. It is known that, in summer, a demand for light drops off to a certain extent. There has quite a large demand come to my notice in this city, which, I think, will be well supplied this coming summer.

MR. CURTIS: The Brush Company of Cleveland is to-day running, not as an experiment but on a regular commercial basis, street cars on a track of a mile and a half in length. Work has been taken up by our leading street railroads, having made a thorough test of it, and it has been running something like nine months. It has given perfect satisfaction, running through the snow and rains, and the road Company intend to extend it over their full line, which will embrace probably ten to fifteen miles of track. One dynamo is placed under each car between the

wheels and that connected with rods running between the rails. These rods are connected by wires carried on poles over perhaps a mile of wire to the stable of the car Company. These motors are seven-horse power. We find a loss in the neighborhood of thirty per cent. as has been stated, possibly more, forty per cent. In other words developing one-horse power will realize sixty to seventy per cent. of the power.

THE PRESIDENT: Does any gentleman present know anything about this motor? Mr. Van Depoele, do you know anything of the principle upon which it operates?

MR. VAN DEPOELE: The motor is about the same as any ordinary electric motor, no peculiarities about it.

THE PRESIDENT: I take it, Mr. Curtis, you refer to what is known as the Knight–Bentley system.

MR. CURTIS: A Brush motor in connection with the Knight–Bentley attachment.

MR. VAN DEPOELE: Mr. Hochhausen of New York is here, and I would like to hear from the gentleman.

MR. HOCHHAUSEN: So far as my experience goes, and that of everybody in the business in Europe, the electric power is a success. On the Continent there are five electric railways operated, some six miles, some three miles, others a mile and a half long, and one in Ireland about fifty miles long. Seiman in Germany carries his current in a copper tube, which is held up by steel wires. The tube is about three thirty-sevenths inch thick copper and the diameter is three-quarters of an inch. The efficiency of the motor is not great. I do not think Mr. Seiman has ever claimed any more than fifty per cent. efficiency for it. They are made on a false construction, the magnet being too small for use. That may be the cause of such a large loss. In New York city they have quite a number of motors driving fans to cool offices.

I saw last summer a small railroad on Coney Island running the whole length of the pier. I think they carried during the season about forty thousand passengers at ten cents apiece. The plant was cheap, consuming perhaps six-horse power. Of course there was no leakage, in consequence of the distance being only

about seven hundred feet. The Daft system has a low-down current and very heavy conductors, consequently does not use much current. They use ordinary rails. In wet weather there is a leakage through these. The only practical railway so far invented in this country is the railway spoken of by Mr. Curtis.

MR. VAN DEPOELE: They are having at present a movement going on in New York by different companies that are invited to test their electric motors on the elevated railway; and in this test the Edison, Field, Daft and several other companies will in the course of a couple of months show the practicability of running trains by electricity, and it will add a great deal towards confirming the practicability of applying electricity as a motor power.

MR. CURTIS: I will ask whether, in Europe, they are enabled to run two cars in opposite directions at the same time.

MR. HOCHHAUSEN: Yes, sir.

THE PRESIDENT: Mr. Curtis asked the question whether there is any electric railway abroad where two trains may occupy the same track, running from the same machinery, from the same current.

MR. HOCHHAUSEN: On all foreign railways they do that.

MR. CURTIS: I would ask whether they do this by using the same current?

MR. HOCHHAUSEN: They do.

MR. VAN DEPOELE: It does not require any invention at all to make two trains, or ten, move on the same line in opposite directions. Only, it would not be advisable to have them move towards each other with much speed.

A MEMBER: I would like to know as to the efficiency of the Field method; what percentage of power they get from that motor?

MR. HOCHHAUSEN: I have never seen it.

A MEMBER: At the Exposition of 1883 a Field motor was there running a railway. They had a 150-horse-power Corliss engine running four cars, and the engine stalled.

MR. HOCHHAUSEN: There has been a great deal of talk about the Daft motor being placed on a railroad on the Brooklyn bridge,

but that seems to have been only talk up to the present time. The Daft motor has not yet been placed on the cars on the Brooklyn bridge.

The President: I suggest to the gentlemen of this Convention that, when the recess takes place in the middle of the day, they will find it very interesting and very instructive to visit at that time the workshop of Mr. Van Depoele. I spent two hours there to-day. You will learn a great deal about electric motors if you go there and examine his plants. You will get information there you cannot get on this floor.

Mr. Van Depoele: With pleasure, I would like to show them what is to be seen in those shops.

Mr. Sperry: In regard to the subject of motors there seems to be, in the popular mind, some misapprehension regarding them.

Mr. Sperry then explained in regard to the distance of the circuit, and consequent loss of power, where the dynamo was separated from the motor at long distances.

Considerable discussion was entered into as to the law of averages, whether it would be practicable and safe to sell a larger amount of power to various small consumers than the plant was able to produce, and the general opinion expressed by those participating in the discussion seemed to be that, according to the law of average, only a certain per cent. of the consumers were using the power furnished at the same time.

The President: I present the following resolution, which has been offered by Mr. Hovey.

"*Resolved,* That a committee of five be appointed by the Chair to consider and report upon the advisability of forming an Electric Light Association, with authority to submit a plan of organization."

The resolution was unanimously adopted.

The Chair appointed as such committee Mr. Hovey, of the *Electrical Review;* Mr. Brown, of the Western Electric Company; Mr. Bowen, of the Van Depoele Electric Light Company; Mr. Sperry, of the Sperry Electric Light Company; and Mr. Bullock, of the Brush Electric Light Company.

The President: There is one question here that ought not

to take very much time to consider. I will read it. "Where an electric light system requires No. 6 conductors, is it desirable to use No. 6 and No. 4 in the same line?" I think that question will be settled in very short order by some gentleman.

MR. PLACE: I think that question is readily settled by considering the amount of waste in the circuit. Using a large conductor you save more power. It costs a little more for copper. Now one of the best electricians in this country, or rather in the world,—I think, probably, the best electrician that I know of, Sir William Thompson—has demonstrated that the size of the conductor should depend upon the price of coal and the price of copper. He made calculations on the price and cost, and put up a circuit, and the cost of an electrical horse-power depends upon that consideration. I think his opinion is worth as much as any man's living. He is not only a theoretical scientist, but a practical electrician. To put two different sized wires in a circuit is a question of expense, and should be settled with these considerations. It is to be settled by trial and our individual judgment. Of course on a long line it might be advisable to use No. 4 wire. I say that would depend upon the cost.

MR. RANDOLPH: I think that question came up in this manner: The party claimed to have a line to be used which has a No. 4 already up. Their system requires a No. 6. They can use a No. 6, and do use it with their system. That is easily answered. If they can use No. 6 they can use No. 4.

THE PRESIDENT: The explanation makes the case plain. If he has already a No. 4 wire and wants to piece it out with No. 6, and the No. 6 carries a sufficient current it is competent to do it. You can go from a small wire to a big one, but the big one will do the work.

Here an adjournment was taken to Thursday morning, at 10 o'clock.

MORNING SESSION.

THURSDAY, FEBRUARY 26TH, 1885.

The Convention was called to order at 10.30 o'clock by the President.

THE PRESIDENT: The first business in order is the report of the committee to whom the matter of induction was referred, who asked for further time. The Committee on Permanent Organization are present, and they are to report. The first question to be taken up this morning is "Special insulation, or guards to insulation of lines at dangerous points and places."

MR. PLACE: I would like to hear Mr. Haskins on that question.

MR. HASKINS: I did not expect to say anything on this subject. I do not know that I can say anything particularly to interest the Convention. There is one point, however, mentioned yesterday by Mr. Hovey with reference to the danger of underground wires. In the course of my experience as inspector, I have found that there is danger at the terminals of these wires. We have in an ordinance of our city a requirement that all wires for electric light shall not only be approved but fireproof. We get the best we can and have them satisfactory, but at the terminals of underground wire, where it comes up to the surface, I have found very many times serious trouble, arising from condensation of moisture at that point. It approaches over from the lead cover and the wire proper through the insulation, and, of course, makes a bad spot there. We have remedied that in every instance by thoroughly insulating them with paraffine or some sort of tape, carrying that insulation out, ending it in a sort of a tit, and winding it down until it ends in a single thickness, which we cover thoroughly with some insulating material.

We are not condensing moisture to any extent, and from some remarks that were made here yesterday, I am satisfied that a large number of the lines throughout the country in many cases probably have grounds. As we all know a single ground will do no mischief, but a second ground will, if it is in the proper place, short circuit a machine, and become mischievous. The

custom of testing their circuits by means of magnetos is very common among all electric light men. These magnetos usually range from ten to fifteen thousand ohms only. If the insulation is left at that point, the magneto will tell no story of the ground, yet there may be a ground that would be dangerous. The only method that I have found for testing positively a ground, is by the use of the "Wheatstone bridge" and galvanometer. With that we get here a million ohms as insulation against ground, on which we give a certificate. Another peculiarity in that lies in the fact, that if the other end of the wire is open and it is a long circuit, the static capacity of the wire enables the bell to ring when there is no ground on at all, and in many instances a ground is supposed to exist when there is none. The magneto instrument is an alternate current instrument. It sends a positive then a negative, then a positive then a negative, so on continually, and one will neutralize the other. The bell will ring when there is no ground at all. We have here the case of a cable about a mile and a half long, in which the magneto will ring and the galvanometer show no mistake. There are two points in the matter of insulation of the incandescent system which are perhaps interesting. The laws of New York, of Chicago, and, I think, of other cities, require that the positive and negative wires leading from the machine, shall be placed at a positive distance apart. In one case it is 2½ inches, and in the other I do not know what the distance is. The question came up some time ago whether it is safer to place those wires further apart or nearer together. After some conversation which we had upon that point, Mr. Work, of the Edison electric, and myself, made a series of experiments by way of a test. It was understood that soft metal strips be placed in the lines. We made sixteen experiments. It is of no use to detail those, which were all public, but the result proved to us conclusively that the nearer those wires were brought together the safer they are, and for this reason: when they are near together the escape which takes place is of very little resistance. It will go over without injuring the wood except melting out the plug. When a slight escape from one or the other is long continued it will eventually render the wood, or other combustible

surface over which it passes, highly combustible, and when the spark does escape there is a nice little pile of kindling wood to start a fire. I do not know that I have anything else to say on this subject. If any one wants me to answer a question I will be very glad to do it.

A MEMBER: I would like to ask what insulation they use here through wet places such as rooms where steam condenses?

MR. HASKINS: We insulate as thoroughly as possible from the surface, and begin that by drawing the wires as tight as we can, to keep them from positive contact; and in such cases as you speak of, we use a wire that is thoroughly insulated with paraffine in the first place, and covered with pipes. We use that in ordinary cases, but where it is very damp we use a wire which is called a cable wire—a wire that is thoroughly insulated with paraffine inside a lead pipe.

A MEMBER: Have you found any trouble with this lead pipe, the covering pipe of the wire, in making short angles breaking the insulation on the inside of the wire?

MR. HASKINS: I have not found anything of that kind.

THE PREVIOUS SPEAKER: I do not know whether it is caused by breaking the insulation, or poor construction. I found in making short angles in a damp room, where the temperature changed often from 85 or 90 down to 32, that the seams condensed water on the change of temperature, and made a moisture inside of this lead pipe.

MR. HASKINS: In a case of that kind I would recommend the use of an air-tight pipe, that is, the wire in insulation completely to fill the pipe. A wire placed in there would allow that condensation, and as I remarked, all our wire is not proved to be fireproof. A short angle bend in it will, of course, stretch the outside, and compress the inside curve, and, probably, in one or both cases a little moisture there will give you a ground.

THE PREVIOUS SPEAKER: In this same room we conducted the wire through an iron pipe, and filled this iron pipe with melted resin. The resin was not hot enough to affect the underwriters' pipe. We could get no short circuit from the pipe to the

wire, but, eventually, the heat in this room going up to 80°, we found that the resin melted, and there was no way to get it in evenly, without leaving the underwriters' wire comparatively bare of resin. We found serious trouble with that. Perhaps it would be well to say we tried five different ways in this room. The first was through lead pipes. The second was with a gas pipe and resin. The third was through gas pipe with melted paraffine poured in. That seemed to be a success, except that we had the same trouble, to a certain extent, as with the resin. The fourth was what is called—(I do not mean to advertise any wire man. The name of the wire is given so you may know what it is)—paraffine wire. That is, two wires running parallel with jute between, covered with an insulation. This was said to have been run under water for some two weeks, without getting any ground. In making short joints and short angles, in some places it is necessary to do that. In making these short angles we broke the insulation inside, and that is the reason I asked if you found broken insulation inside the lead pipe, and got a ground in that way. We got a slight ground from the last wire we put in. This was rubber-covered wire. It seems to be a solid rubber covering on a regular copper wire without being tinned, or without any insulation between the rubber and the wire. I judge that to be so by its becoming a little oxidized whenever we cleaned it to make a joint, which is covered with a rubber tape. We put that on the porcelain insulators to keep them away from the wall. Even when it goes through a wall we have wound it with other tape, and then put over that a stout one, so that in no place is the wire exposed to this moisture without having at least one more covering than that which the wireman puts on. But still we get slight ground, not a ground that will ring the magneto as you say. But if I have one pole on a clean gas pipe, and take the other pole in my hand, and take hold of the wires, and place myself in circuit, then turn on the magneto, I can find there is a ground, such a ground as would not bother one. I have come here to find out more particularly, whether there is a way I can put up a wire through such a room

in order to be entirely insulated. I hope some one else will give his opinion on that.

Mr. Haskins: It is pretty difficult to prescribe for a sick child unless you can see the child.

Mr. Donaldson: You have the child right there and it is wet, too.

Mr. Haskins: As a wet nurse I have never been a success. I suppose, from your description of it, one of two things has probably happened. Either that, as you suggested, you have broken the insulation and have a wire placed in there which will condense moisture under a proper temperature, or that at the terminus, where your wire comes out of the lead pipe, you have more or less moisture than that.

Mr. Donaldson: This last year we put up a rubber-covered wire without anything on it but the rubber tape on the outside. It seems to be a solid rubber insulation.

Mr. Haskins: I have had some experience with most all these tapes, and I find, in nearly every instance under favorable circumstances, they will absorb moisture in spite of the guarantee given. The only way to remedy the matter is to boil with paraffine until the moisture is gone, then smear asphaltum on the outside, some three or four inches beyond the connection with the lead.

Mr. Donaldson: Then you have found heat, moisture, and fire. I make a distinction between heat and fire. I do not think that, after it is wet as it is in this room, any fire exists there. This is on an incandescent circuit, and of course, once in a while lamps will act badly, the wire will get hot, and there is an amount of heat not in a normal condition. I never had a fire in that room from any sort of a break.

Mr. Haskins: Under ordinary circumstances, to prevent a fire with the incandescent system, if you have a soft plug I would split it, making it half-size so as to give off quicker.

Mr. Donaldson: These rubber wires run entirely out of this room into a perfectly dry room, as dry as this is. There is where we join to the regular underwriters' wire.

Mr. Haskins: There is one possibility, and that is the possibility of induction on your outer pipe from which you might get an effect and still not have ground.

Mr. Donaldson: We have no outer pipe on this system.

Mr. Haskins: No outer pipe at all? Then you have no induction.

Mr. Donaldson: We have done away with all fixtures. We have both wires go to the lamp, and cover it in one case with melted brimstone, then cover that with the last covering. In another case we take resin and asphaltum together. In another case we take soapstone. In the last we simply take rubber tape wound around so as to make a coil, and over that we put asphaltum. We do not have any trouble at that point.

Mr. Haskins: May I ask you how these lamps are attached to the ceiling?

Mr. Donaldson: We have taken the porcelain insulators and from a beam that runs through the room we have taken one wire one side and one on the other, and hung the lamps on these wires; the weight of the lamp is very little. I looked in every instance to see that the plug is put in the top holder. Where the manufacturers of the electric machine put in their gas-pipe, I put in a block of wood and put wires both sides of that, so that when I wound it with a tape this piece of wood was between the two wires fitted into the holder of the lamp.

Mr. Haskins: What wood have you?

Mr. Donaldson: We use soft pine; but before using it we have it thoroughly dried, and before any moisture can get to it, when it is warm, we cover it with asphaltum and let that dry, then put on three coats of asphaltum and let each coat dry by itself. We then put it into the holder.

Mr. Haskins: There is no cord connection between the ceiling and the lamp at all?

Mr. Donaldson: No, sir, the only connection is just the two wires that run to the lamp.

Mr. Haskins: Have you ever looked at the insulators to see whether they can condense moisture?

Mr. Donaldson: Of course the insulators are like all the rest of the room. The moisture condenses on these insulators as well as every other part of the room.

Mr. Haskins: May it not be a little dampness of the wire in the crease of the insulator where your tie-wire goes on? You know it is not uncommon to break the insulation where you put on the tie-wire; moisture on your insulator, moisture on your tie-wire, and about the main wire and the bridge across, might give you a slight ground. I found such a case as this. In a building which had been recently put up in which it was assumed by the builder that all the timber was dry, an arc lamp was suspended from a screw-eye in this dry timber. I found a very serious ground right where that screw-eye went into the dry timber. In another case we exhibited the lights in a town where the lamps were suspended by a cotton cord about as thick as a clothes' line, and we found the ground at almost every one of these lamps through that cord which was over thirty feet long and tied and fastened to the rods which supported the roof.

A member: Does that ground give a ring on the magneto?

Mr. Haskins: No sir, it does not. I found, in a circuit of some 25 or 30 lamps that ran around a building, a ground on almost every one of them by means of a galvanometer. In addition to that, a circuit in the same building had been run along the timbers of the side of a sort of amphitheatre building with wires on ordinary insulators. The painters—whom I have no doubt you all love—came into the building and painted with cheap paint, like that used on the stage, all over the wires, insulators, and everything else. That whole circuit had to be taken down and re-run in order to get away from that paint. There was ground everywhere. That was on dry timber in a building seven or eight years old. The room was filled with moisture from a steam engine, and the places to look for ground were almost unlimited in number.

A member: I would like to ask if you have had any experience with rubber tubing? If you found that it seemed to carbonize? I do not know what you call it—regular rubber tubing.

Mr. Haskins: India rubber is vulcanized by the use of sulphur. Sulphur will always draw moisture and develop sulphuric acid. Sulphuric acid is *conductive.* I have seen a piece of hard rubber, taken out of an American District office, where the circuit positively refused to work because there was a current across the tube of hard rubber. That same piece of hard rubber on being polished with a piece of chamois skin was just as good as before. The hard rubber in telegraph use will absorb moisture which developes sulphuric acid. Soft rubber is vulcanized to some extent.

Mr. Bell: I would like to ask whether the leak described by you, when the lamp was hung by cotton cords 30 feet long, was of sufficient magnitude to be determined on the circuit or dangerous?

Mr. Haskins: The total amount of leak in that case was of the difference between forty thousand and a million of insulation. The total insulation I got with those cords hanging in that condition, damp as they were, was forty thousand. I put in insulated rings in every case on these lamps and got the million.

Mr. Bell: What I wish to get at is this, was the leak sufficient to be attended to, or of sufficient importance in commercial use really to need correction?

Mr. Haskins: I think so.

Mr. Bell: Was there any danger of fire?

Mr. Haskins: That would depend on circumstances. A leak of that kind has a tendency to increase rather than decrease under ordinary circumstances. Those circumstances which would induce a leak from dampness would probably increase that leak.

Mr. Bell: Then, sir, would you permit an electric wire, a common bunch of wires, to be buried in cement, plaster of Paris, or ordinary plaster, between the floors or any section of the floor where the room is dry?

Mr. Haskins: We do not do it here, sir.

Mr. Bell: Is there danger of leak in that place?

Mr. Haskins: I should think there might be. I would be

afraid of it. As you are aware, Chicago has a sort of black eye in this whole business. We are called cranks here because we are so particular. But if I were to detail to you the peculiarities I have found in lines about this city in my explorations you would be perfectly astonished; and I think the electric light company in Chicago—all of whom I look upon as my friends—will bear me out (and I mean what I say)(Laughter) in the statement, that they are satisfied with the restrictions under which they have been placed, and feel that they have been a benefit to the electric light people as well as to the city in which these laws have been carried out.

Mr. Bell: I would like to ask one more question. For an incandescent light in a warehouse where there is a brick partition, and the walls are plastered on the brick, would it answer to run down the side? And what kind of insulation would you put in?

Mr. Haskins: We use underwriters' wire and put it underneath a piece of moulding. As I said before we allow the wires to run close together and put in a soft plug.

Mr. Bell: Suppose the owner wishes the wires out of sight after the house is finished, it being in process of erection?

Mr. Haskins: In one case where that was done we never got our measurement. The dampness lasts nearly as long as the child is growing up. In my experience it is very permanent in a wire when it once gets into it.

Mr. Place: There is another consideration which I think it would be well to speak of in this connection, not only from a commercial point of view, but also to insulate the wires so as to be free from all danger. In the arc circuit and even in the incandescent circuit, it is a matter of safety to human life. It very often happens that wires have to be run very close to passageways and in places where persons are very apt to run against them. It seems a matter of importance that there should be extraordinary precaution taken to insulate these wires so that there could be no contact with people who are passing. I do not know how that is best done, by enclosing them in pipes or by

proper insulation inside. Another thing is in running arc circuits. It is very important also to indicate distinctly, when wires are put out of sight, just where those wires run. It can be done one way or the other as may seem best. It very often happens that an accident takes place, in which case it is very necessary to know where these wires are, to get at them. When wires are put in behind a partition, the workman does not know in what direction to work; he must find the wires and fix them in some way. The ground must be found, if it is grounded, and wires should be put up in such a way that they can be most easily reached. It does not seem to me advisable to run wires in places where persons cannot get at them. It should be indicated just where they are located. And also on an incandescent circuit, it would very often save a great deal of trouble and expense if these men could know beforehand where to find them. In an arc system circuit, where a high tension current is used, and when a ground occurs, the ground may not be sufficient to materially affect the burning of the lights, therefore a person has to come in contact where it is grounded. It is safer to save a shock and injury; so it seems entirely proper to speak of this matter. When wires are near, and in sight, especially when they come near the floor, there should be particular caution used in guarding against any possibility of contact.

MR. HASKINS: With the most delicate test you may find, you have perfect insulation, as perfect as can be made, and subsequently with the same dynamo you will find a ground. Dirty oil is a conductor, and oil that has run off a machine containing small particles of metal dust from the building, will eventually run to the ground from the machine and from the ground to the foundation plate on which it stands and after a while it will give you ground there. In testing for ground it is always my plan—and I think it is a good one—to test with the dynamo on the start. Then if you have ground take the wires off and test the dynamo and sometimes you find the whole trouble right there.

THE PRESIDENT: We will pass to the next subject, "Will armatures become affected by frost when exposed in transportation?" So far as my experience goes, with regard to armatures for dynamos in general becoming affected by frost, it is something which I do not believe. I know, that, in a few instances, there have been dynamos, which have been shipped, that refuse to start up. The man, putting the dynamos up, said that frost was the cause of it, the dynamos being so cold that the life was out of them, and would not work from the effect of it. Afterwards, I came to find out that this man did not know how to connect the dynamos. Sometimes, in stopping, dynamos may get reversed and the poles demagnetized, and the magnet is not sufficient to start up again. In such a case, by simply using another dynamo, it will be right again, or even a hard rope and a hammer oftentimes will bring the polarity in its proper place. But, as to dynamos being affected by frost, it is simply a ridiculous idea, so far as I am concerned.

MR. SPERRY: I have had a little experience in this. The copper on a wire on an armature being such a good conductor, it becomes frosted very easily, and sometimes white frost gathers on it from the moisture of the atmosphere. Sometimes, moisture is a serious thing in starting a dynamo. Frost I do not think will hurt an armature. I do not see how it can.

MR. DONALDSON: I had occasion to send up one of our dynamos to St. Paul from Minneapolis, and we used it there a couple of weeks. In that region of country, it is not very warm and generous, the thermometer standing between 20° and 30° below zero. Getting the dynamo into the station, I noticed frost all over it. I stood the dynamo in its place, and started up as usual that evening; and, to my astonishment, we burnt out the armature. I was a little surprised at this, because it had been running in Minneapolis, two weeks previous to this, and had shown no evidence of short circuit or any other trouble. I took the sections out the next morning, and found that those that had burnt were moist, were wet. They

certainly had been subjected to no means of collecting this moisture only through the transportation from Minneapolis to St. Paul. They could have gotten wet in no other way, and that was the cause of its burning out.

THE PRESIDENT: A very poorly constructed dynamo that will allow moisture to get to it.

A MEMBER: A Brush. (Laughter.)

A MEMBER. We had fire in the building on top of one, and the engines played on it, and we had no trouble.

THE PRESIDENT: That was a Brush dynamo! The next question to be discussed was the first on the list at the meeting yesterday, which was passed by because it was deemed proper to give plenty of time for its consideration: "Incandescent lighting, particularly in regard to length of circuit upon which it can be run with profit."

MR. SPERRY: This question was handed to me late last night, and my time since has been somewhat occupied with committee work. This is a matter of considerable importance, however, and should be treated carefully. The fact that we are not able to transmit a perfect current to a great distance, is attributed, only to the fact that it is a high quantity and a low motor force. The matter, with regard to the transmission of the electric light to a long distance, can only be, in my mind, solved by some method of carrying a high tension current to the point where the incandescent light is to be used. Then there should be a storage cell, or some means, or motor, to transfer the current to a low force, suitable to the operation of incandescent light.

[Mr. Sperry went into quite a lengthy discussion on this subject which, being all technical language, and being uttered by him very rapidly, was not understood by the reporter.]

MR. WADSWORTH: While on this subject, it may be of interest to the Convention to know of a certain matter relating to incandescent lighting going on in New York. I saw at the Gilsey House, on the corner of Twenty-ninth and Broadway, some two months ago, an incandescent lamp. I asked the proprietor, whether he was putting in an insulated incandescent plant? He

said, no; it was from the central station. Afterwards, I found the man who was putting it in, and he told me that that incandescent plant was being operated from the Stanton street station running a No. 6 gauge a distance of about four miles and a half to the Gilsey House. I went to the Stanton street station one evening, and I looked it over, and found that they switched from their arc lamp on this incandescent circuit, and *vice versa*, without any particular trouble. I do not know whether it is a good thing or not. I simply state for the information of the Convention that the miles of wire in the circuit, I think, are about four and a half.

MR. RIDLEY: I would say that has been done in Boston. We had a play produced at the Boston Theatre, for which we let a large number of incandescent lamps. The play was representing light from electricity. In one part of it a queen of light had four incandescent lights in her hand and three or four on her head. We took a loop from an arc light circuit, brought it down on the stage, and put in sufficient resistance. When they were lit, these six or seven incandescent lamps took the whole force of the current. When we were lighting some three hundred in another part of the play, we were not obliged to use resistance at all. Now that is being done by another company, to a certain extent. In lighting a series of seven lights, we put in the seven lights in place of one arc light, and put in fourteen in place of two arc lights. This is done quite successfully. The question comes up as a matter of economy. Can we do this cheaper in that way?

MR. VAN DEPOELE: As to the matter of conducting currents for incandescent lights, the easiest and most practical is certainly the multiple arc circle, as employed by Edison and a good many other companies, and insures certainly the best results with regard to handling the light, although a multiple series could be run; but there is a big danger, because we will say when a group of engines would have to carry the whole current, if one or two of these lamps should break, the remaining lamps will have to carry the current sufficient for the other lamps, and the current will

increase in the six remaining lamps, and most probably destroy them, unless some automatic arrangement is used shunting away the current. A current passing through that resistance is entirely lost. It would do no good whatever. It simply keeps a passage open, so as to keep a normal current passing through the light. I really think the best mode of propagating an incandescent light would be to use a conductor large enough to run it in a multiple arc system. It requires no current armature to govern that, and, in fact, the current which already has cost a good deal of money is lost.

Mr. Cleveland: We recommend this plan for lighting a city. We put in a central station, then divide the city into square miles, for each of which there is a sub-central station, and in that way light all parts as you desire. Of course, that rule holds good to any extent. You can light the United States in that way if you choose. I would refer you to Mr. Van Depoele, and would like to ask him what he thinks of the plan we have adopted, which is working successfully so far as our incandescent light is concerned.

Mr. Van Depoele: You have one central station?

Mr. Cleveland: Yes, and sub-central stations in the centre of a mile square. We carry the current half a mile, which is as far as a current can be carried economically, because the further you carry it through your cable the heavier the cost, of course.

Mr. Van Depoele: But to the sub-stations the current is furnished from the main station. It would be merely a matter of covering your areas, and certainly a plan could be devised by mapping it out to see exactly how heavy the current would likely be at the sub-station, and from thence branch out with smaller wires. I think it is fully as practicable as anything I have heard yet. I think that could be done in a first-class manner.

Mr. Brown: I move that when this Convention adjourns it adjourn to meet at two o'clock, and also that it adjourn *sine die* at four o'clock this afternoon.

The motion was adopted.

The President: "Street lighting, the best manner and modes of accomplishment, location of lights, etc." I will ask Mr. Bowen to present that case.

Mr. Bowen: May I divert the attention of this meeting for one moment, before I speak on street lighting?

The President: Certainly.

Mr. Bowen: It refers to the publication of the Proceedings of this meeting. As a member of the Committee of Arrangements, I would be glad if the Convention would give some expression concerning the publication of the minutes of the meeting. We have had a stenographic report, and if it is the pleasure of the meeting it should be published, I should be glad to know it.

The President: The best way is to present it in the form of a motion.

Mr. Bowen: I move the Proceedings of this meeting be published in pamphlet form for distribution among the members of this Convention, and also for general distribution. The motion was seconded.

Mr. Weeks: I will amend that to this effect: that it be done under the supervision of Mr. Hovey, our secretary, and that he be authorized to employ an assistant to compile and arrange the report for publication, and have this report started out under his own supervision.

The amendment was seconded and accepted by Mr. Bowen.

Mr. Yarborough: As Mr. Hovey lives in Boston, should it not be done by some one who is here? Mr. Hovey travels all over the United States.

The President: Where are you going to get the money to pay for it?

Mr. Hovey: Let me say, that our committee met this morning, and were engaged in drawing up a scheme of organization. The committee will meet again immediately upon the adjournment of this session, and we hope to submit our report at the beginning of the afternoon session. I will take the liberty of asking on behalf of that committee that this vote, which I presume looks to the publication of the Proceedings of this Convention, be deferred until after you hear the report of the committee.

Thereupon the motion was laid upon the table.

Mr. Bowen: On the subject of lighting a city there are, of course, many different systems that have been adopted. I have seen some cities lighted, and you all have, with lights placed on poles on the corners of streets, and many cities are lighted by lamps hanging at the intersection of streets. Some cities have been lighted by the use of towers. To illustrate these various systems, for instance, the suspension of lamps at the intersection of streets, I would cite Nashville as being the best arranged I have seen, and I have seen many cities lighted in that manner. They have two posts on the diagonal corners. The light is 35 feet above the street, and is permanently placed on an iron frame, so that the attendant who takes care of the lamp comes to it, puts in his carbon, and retires. As regards economy, my judgment is that a light, or a group of lights, placed on a tower, say 125 or 150 feet high, would give better results. Where cities are closely and compactly built, of course a tower would not do so well, but in a great many cities, where the streets are broad and the houses are not compactly built, a tower system is best. It lights the entire area of the city, the alleys, and the yards, and I think that is quite as important as a police force. I have had a great many gentlemen speak to me about the lights in the towers and their appearance, and I have often heard men say it was unnecessary to take a light to the barn in driving in, or in harnessing a horse, and all that. My conclusion on this subject is that six lights placed on a tower 125 feet high will do as much good work, and as efficient lighting, as eighteen lights will on poles, or placed in any other way that I have seen. In the cities of Denver, Fargo, Fairfield, Dayton, Lacrosse, Evansville, Ind., Savannah, and Macon, Ga., towers are used. The city of Detroit has 90 towers, with 360 lights, and I have heard many expressions of approval of the manner in which that city is lighted. Some newspaper discussion on that subject was had, and opinions both favorable and otherwise were made, and I think the general expression by people who are observant and view without prejudice is that the city of Detroit is very handsomely lighted. We light the city of Elgin in that manner. We

have 33 lamps placed on 8 towers. We estimate that a tower with 6 lights will light a radius of 2000 feet very handsomely, substantially a mile square, and I know no way in which you could get such good results, provided everything else was favorable, as you can by placing your light in an elevated position. The city of New Orleans had some experience recently in that direction. In the Exposition grounds, are 5 towers and 10 lights on each tower. The result is very gratifying, indeed. The Brush Company in that city has recently put up 2 towers, and is about to put up 16 more. The city authorities have satisfied themselves that this is the most economical and the most satisfactory way it can be done. I have given this matter a great deal of consideration, and I make my statement as concise as possible without taking up too much of your time. My judgment is clear and definite that it would be the most economical manner to light a city. One tower at Minneapolis is 267 feet high, and has 8 lights on it; and while it is very handsome and beautiful, I do not think they get as good a result from that as they would if the tower were 100 feet less in height. I have requested a young man to present to the delegates here a little diagram, showing the manner of the erection of towers at Elgin for your information and discussion.

MR. WEEKS: I have had no experience in city lighting, but owing to the demand in our city for public lighting, I have investigated the two systems, pole lighting and tower lighting, and have gotten together considerable data in regard to them. I find, after a careful examination, in those cities which are lighted by towers, that there is considerable dissatisfaction, especially where the streets are narrow and crooked, and the buildings are high. In some of the Western cities, where the streets are broad and running at right angles, I find that it gives tolerable satisfaction, although there are objections to it there. The city of Topeka, Kansas, was lighted with towers until quite recently. The inhabitants of the place complained that at the base of the tower it is dark, and for a belt of half a mile there is a tolerably fair light. The light is placed at a height from which it shines down

at an angle of forty-five degrees, thus lighting this belt. After you pass through that belt you have darkness all outside. The dissatisfaction we had became so general that we cut off the tower and went back to gas. I understand that in Detroit there is a great deal of dissatisfaction with the tower system, although it is infinitely better than gas. They think they can obtain better results by placing the lamps at the intersection of streets, on poles or suitable fixtures. I find in the city of Quincy they light the city wholly by electric lights placed on poles or tables at the intersection of streets. They place one lamp in the business part of the city at each intersection, at a height of about 35 feet. The length of their plot is 600 feet. I carefully tested for dark places, and I found none in the business part of the city. I could read nonpareil print on a very dark night just by the aid of the electric light. In the residence part of the city they place their lamps at every other intersection, and they light the city very much better than it was lighted by gas. The satisfaction is general. People are very much pleased with their light. So it seems to me, from all I have been able to gather on the subject, that the best method of lighting a city generally, is by poles placed at the intersections of the streets. And, as Mr. Bowen says, I would have these lamps placed in a circuit rigidly, with no tackle, with no chance for terrible contact, no chance for breakage, or dropping, and killing people and destroying property. In Quincy they have a great deal of tackle which is objectionable, but in every other respect their system is an enjoyable success.

Mr. Johnson: The city of Elgin is lighted up very finely and properly with 29 lights. The city of Elgin covers just about half as much gr6und as the city of Quincy. The city of Quincy has 125 street lights to light that city. Now Quincy is well lighted, it has more than twice the number of lights to the same territory, of course more than twice the expensive light than by the tower system. I have been an advocate myself of placing the lamps at the intersection of cross streets until quite recently. I will illustrate the tower system by the lights on the court house at the city of Rockford. They have four lights there. At

night I went out to make an observation, as to the strength of the power of these lights. I went more than one thousand feet from the public square. These lights are 120 feet high at the centre of the public square, and there was no other light shining upon me except the electric light, and my shadow could be seen upon the fence near where I stood as plainly as about half moonlight. All around that public square there was just as beautiful light as I have ever seen anywhere, and as effulgent. I could easily read a newspaper anywhere around that square or anywhere within five hundred feet of these lights. Now I was extremely careful, because I was to advocate the lighting of streets from the centre of cross sections. And another special benefit of these lights in that position is that on a bright moonlight night you do not really need the electric light. If a storm comes up you can start your machinery, generally, and light the city. When all the stars are shining brightly, the electric light, placed almost anywhere, will light a city well. But on a cloudy night with four of these lights placed in a position to collect the light from the cloud, I have no doubt every alley is lighted. I am told that you can see to drive your carriage very well along the country road, where the city is lighted with these lights. Now in reference to the shadows. A casual observer walking along through the streets of Quincy, Illinois, for instance, under these extremely bright lights, as I have done many a time, walks under its intense rays, and sees everything brilliantly lighted around him. He is pleased with the appearance of that scene. When a man goes into a city which is lighted with these lights, placed at the crossings of the sections, he may be delighted with them on account of the brilliancy of the light shining in the immediate vicinity. Another man will form his judgment favorable to the general diffusion of light which enables the people to go about. I have been converted to the tower system just on that account.

MR. YARBOROUGH: In regard to our lights at the intersections of streets, we had a very strong fight with our gas company before the city authorities would permit us to put in any

electric light whatever. The objection in part was that the suspension of these lamps over the streets was very dangerous. The city authorities then required us to put up something of a very substantial nature. We did so by erecting posts at the corner of streets diagonally across, and then throwing an iron arch made in the shape of a ladder from one of these posts to the other. The men in adjusting these lamps go from either corner to the lamp, and are certain there can be no difficulty in securing a lamp. As evidence, we have been running there three years since last November, and never had a lamp fall yet. The lamps are made perfectly secure, and we get to them without any trouble from either of these corners. After climbing up the posts we walk on the ladder-way to the lamp. There is one wide streak of light. We use a cable. We have a pulley cord at each end so that in case one should be out of order we can pull at the other post. That street is about 100 feet wide and we use an iron cable there. At all the others we have an iron arch.

MR. MONTAGUE: We commenced our street lighting in the winter of 1882, in January or February. The first street lights were erected for exhibition. We put six of them on the principal corners where we could fasten our cable across from building to building, so as to light every intersection of the street. We hauled them in to the roof on either side for trimming, and some of them we let down. We abandoned that plan after awhile, not liking it. We finally contracted with the city to light it by four towers, and this we have done ever since with towers 150 feet high. On these towers we placed three 2000 candle-power lights and they gave satisfaction. We have also placed and are now using lamps suspended from posts or arms set at the curb or corner of the street reaching out nearly to the centre of the street. A lamp thus suspended by an arm can be let down to be trimmed. We like that much better than any other system. We have been able to save, learn, and have experience too.

On motion an adjournment was taken to two o'clock.

AFTERNOON SESSION.

FEBRUARY 26th, 1885.

The Convention was called to order at 2.15 o'clock by the President, who stated that the matter for discussion was: "The proper qualifications and wages of engineers and firemen."

A MEMBER: Mr. President, I hope we will not close up the matter under discussion at the close of the morning session. It ought to have further consideration. It is the most prominent thing we have to consider, and there is a gentleman here who wants to say a few words.

THE PRESIDENT: If the Convention so decides.

MR. BOWEN moved that the question of "Street lighting" be reopened.

THE PRESIDENT: I desire to say that we have a little less than two hours. That subject has been exhaustively debated by gentlemen in that business.

On a vote being taken Mr. Bowen's motion was lost.

THE PRESIDENT: The question now is: "Engineers and firemen, their proper qualifications and wages." Is any gentleman prepared to discuss this question? If not we will pass it. "Experience and results in the use of underground conductors."

MR. WEEKS: I thought we were first to have the report of a committee.

THE PRESIDENT: The committee has asked for fifteen minutes more time. Gentlemen, the question is before you.

MR. BROWN: The committee appointed to consider the question as to interferences between the electric light and telephone lines, have a short report ready, and would respectfully report as follows:

"After deliberation, we conclude that the question is one of construction, in which both sides have duties. These

points in the matter of crossing construction are suggested for action. First, that the telephone companies be encouraged to run their lines with metallic circuits. Second, that the return electric light circuit be on the same poles as the outgoing circuit, where possible. Third, that all possible care be taken to keep the electric light line carefully insulated, and all joints soldered. Fourth, that the electric light wires be suspended below the telephone wires. Fifth, that the telephone companies be recommended to use a cable with an induction-killer. Sixth, that the use of lightning arresters be recommended to telephone companies."

The report was accepted and adopted.

MR. WADSWORTH: In regard to this matter of underground conductors, it being almost entirely new to electric light people, it occurs to me, as we have not much time at our command, that it had better be referred to the permanent organization, as a matter to discuss at the next regular meeting of that Association. It does not seem to me we have sufficient data here to base an intelligent discussion of experience with underground conductors.

Mr. Wadsworth's proposal was accepted, and the discussion of the subject was deferred.

THE PRESIDENT: The next business in order, and the last item on the list, is: "Experience of Electric Light Companies in the use of copper-coated and bare carbons." Mr. Wadsworth, of the Boulton Carbon Company.

MR. WADSWORTH: Mr. President, and gentlemen of the Convention, I did not know this question was coming up or I should not have spoken so often as I have. Mr. Boulton, of our company, is here, but in consequence of his inherent modesty, characteristic of Ohio men, he has delegated me to say something on this question for him. The question of copper-coated and uncoated carbons is an important one to electric light people. I believe the experience of the best posted electric light men in this country, and in Europe, as also the opinions of the best electricians, is in favor of plain carbons for a pure and unobstructed light. The argument in favor of the plain over a copper-coated carbon is,

first, no matter how much pains is taken in copper-coating a carbon, there will be, of necessity, a great difference in the thickness of the copper film covering the carbons. It is a physical impossibility to get them uniform. It is also a matter of impossibility to have every carbon of equal homogeneousness. Now, in cases of that kind, where the copper-coating on one carbon is too thick, and the homogeneousness of one carbon is not as good as that of another, the carbon will burn out. Perhaps all of you that have had experience with a leaf sticking up above the carbon, a sort of shifting of the copper, will notice when that occurs you will find around the bottom of the globe a shadow which largely diminishes the volume of light. Another objection to the copper-coating of carbons is, that the copper will melt, fall down on the globe and adhere to it, frequently cracking the globe, and making it very hard for the trimmers and cleaners to clean up the lamps so as to look well. With a plain carbon, all the trimmer has to do is to dust out a little black carbon dust in the morning; there is none of this copper adhering to the globe, and none of this obstruction to the light in consequence of this copper shaft projecting above the top of the carbon. It is better for the lamps, particularly those lamps which have a guide near the end of the carbon to hold the carbon in its place, as some systems have. You will frequently find in copper-coated carbons rough lumps on each side of the carbon; these largely interfere sometimes with the feeding of the carbon through these little guides. They will catch on one side or the other of the guide and stick in the arc. There is not very much to be said on the subject. But there are two reasons why the Boulton Carbon Company have plated carbons. First, because other establishments have them ; and the next reason is that certain patents claim to copper-coat carbons, and in order to go into the carbon trade at all, we have to go into it generally, and it was necessary to substantiate, not only our rights, but those of every carbon-maker in the United States. I believe that the best and most experienced electric light men in the country agree, that so far as the purity of light is concerned, uniformity of feed and cleaning of lamps and globes, the prepon-

derance of opinion is very largely in favor of plain carbons. The only difference is in the durability. A coated carbon will last from half an hour to forty-five minutes longer, according to circumstances, than a plain carbon. The difference in cost and resistance is immaterial. I have measured with the galvanometer on a line upon which there have been forty, forty-five, and sixty lights kept with plain and kept with copper-coated carbons, and the difference in resistance was unappreciable. I do not think of anything particularly of interest more to say upon this subject. There are other carbon men here, Mr. Reid, and Mr. Wallace, from whom I would like to hear.

Mr. Locke: It is understood that a copper carbon is a very expensive operation, and since the question of the price of the raw material came before this Convention in the discussion yesterday, I would like to ask the gentleman the price of his carbon.

Mr. Wadsworth: Gentlemen of the Convention, it is not a proper place to discuss prices upon anything. Figure copper at eleven or twelve cents a pound and the amount of copper that surrounds the carbon, and you can get very nearly what the value of the copper is, except the labor of putting it on. The price or the difference in price is immaterial. In fact the Boulton Carbon Company does not make, except in exceptional cases, any difference between the plain and copper-coated carbon.

Mr. Parker: I would like to ask Mr. Wadsworth a question if you permit me. It seems to me as a matter of fact that ninety-nine one-hundredths of the carbons in use are coated, and I presume that is the same case with the gentleman's company. It therefore seems to me there must be some reason for it. The drift of his argument is that it is better not to coat a carbon. In other words, why does he not adopt the system of leaving off copper coating?

Mr. Wadsworth: There are two answers to that question, one of which I will not touch upon. The reason why the demand is so much for copper-coated carbons is on account of the increased durability of the carbons. The difference of half an hour or forty-five minutes in the light of carbons is a matter of

great importance to electric light people. In my opinion the best carbon would be a carbon that would last sufficiently long to allow the double carbon lamps in the city to be lighted without any trouble, and uncoated carbons—if any company arrives at that point in the manufacture of carbons—will be able to do away entirely with the copper-coated carbon, and give the electric light people something entirely superior in carbons from what they have now. Mr. Reid could give you some information relative to this.

Mr. Reid: I would like to hear from people who are using carbons first. There are a great many here who have had a great deal of experience, more than I have had. My business is manufacturing and selling. That is about all I can say.

Mr. Parker: It would be very desirable to hear from some of the consumers of these carbons whether they have noticed the difference, if any. I certainly agree with the views of Mr. Wadsworth, yet still I would like to know from actual experience what has been the result among the consumers of carbons.

The President: Give us your experience with coated and uncoated carbons. What is the advantage of coated carbons over the plain ones?

Mr. Van Depoele: My experience with carbons is that the copper-plated carbons, especially for long circuits, are almost indispensable unless you use a very high tension, and then certainly it does not matter whether carbons are coated or not. The life of a carbon is increased by the coating of copper around it. I have, in many instances, tried carbons not coated, and have found that they give a better light, but that the carbon will be consumed a great deal faster, although it does not matter with some different systems, which use high tension, whether carbons are coated or not; but those systems which use the heavy current and low electric motor force want a carbon that is coated. That is my experience in the case.

Mr. Wadsworth: In Europe Mr. Seimen has three different systems, and out of the entire number of carbons used on the continent of Europe, there is not perhaps over one-eighth of them

that are copper-coated, and they all come from America. I do not know of a concern in Europe, unless a new one recently established in Belfast, and that is not in Europe proper, that plates carbons. They all use plain carbons over there. Now Dr. Seimen manufactures carbons, and Hardwood is also a large manufacturer. In meeting electric light people over there, I find they are using almost exclusively plain carbons in the majority of carbons used. The copper-coated carbons come from America. I would like to ask in connection with this, if a plain carbon could be made that would last equally or nearly as long as a copper-coated carbon. In your opinion, is the resistance of a circuit increased enough by the mode of copper-coating to make it a matter of material importance?

MR. VAN DEPOELE: As I said, where they use a high electric motor force I would prefer to use the carbon not plated, because it gives a better light; but in a system where the currents are of low electric motor force or heavy quantities, there I prefer a carbon that is plated. In the sixty-light machines in a small circuit, such as they use in Europe, they do not use as small a machine. That is the reason the Seimen company are using carbons not plated, because they use small machines of twenty lights. In that case it does not make much difference whether the carbons are plated or not, if they have good carbons. I have used some of Seimen's carbons, and they work beautifully. They are very expensive, but they seem to take more care in the manufacture than we in America.

MR. WADSWORTH: On the question of resistance, Mr. Van Depoele, if a plain carbon could be made of sufficient durability, and on a circuit ten miles long, in your opinion, would the resistance of a plain carbon over the resistance of a copper-coated carbon be material?

MR. VAN DEPOELE: Not on a small machine.

MR. WADSWORTH: Take it on a 160-light machine.

MR. VAN DEPOELE: Yes, I think I would prefer copper-plated carbons there.

MR. WADSWORTH: I will state for the benefit of Mr. Van Depoele that I have measured with the galvanometer, as I stated

before, on a circuit over six miles long, with sixty lights kept with plain carbons, and the same circuit kept with copper-coated carbons, and there was not a full ohm difference in the resistance of the circuit.

Mr. Van Depoele: That may be. The carbons heat up when they are not plated, and certainly they bring in actual conductivity which is wanted; you are certainly expending a great deal of current heating the carbons, in order to get at the maximum resistance.

Mr. Parker: I was going to ask Mr. Van Depoele a question. I wanted to ask if he experimented with plain carbon?

Mr. Van Depoele: Yes, sir.

Mr. Parker: And did you find much difference in the carbon?

Mr. Van Depoele: Yes, there is a great deal of difference. The difference is not large in one carbon. It would not, in fact, in a small machine of eight or ten lights, make any difference, especially where the machine has an electric force of eighteen to twenty-four, you would have carbons plated; the non-plated carbon gets too hot for the lamps.

Mr. Parker: Whether there is much resistance in the carbon in the same machine, whether much difference in the carbons themselves?

Mr. Van Depoele: Certainly, there is a great deal of difference in that because some carbons are baked better than others. Those baked the best are the best conductors. In one case you will find carbons vary a great deal; in some cases you will find carbons will not be heated at all, while others get so hot you cannot touch them.

Mr. Parker: Then if there were uniformity in carbons themselves, uncoated carbons would be the best?

Mr. Van Depoele: Certainly.

Mr. Donaldson: I do not know that I can help you out much, but our experience has been that we have to get a good plain carbon to burn the best light. The duration of the plain carbon is not quite as long as that of the copper-coated. That is a matter admitted on all sides. But as far as our experience goes in

St. Paul we take the plain carbon every time in preference to the copper-coated, provided it is as good. We claim we get just as much light. The lights are just as bright with the same amount of current as we have with the copper-coated, and I have tried this off and on many different times during the last three years, and I am convinced so far as our system goes, that the plain carbon is the best for us.

THE PRESIDENT: Our experience is the reverse. We have an unsteady light with the plain, and a comparatively steady light with the copper-coated carbon.

A MEMBER: What system is the gentleman using?

MR. DONALDSON: The Fuller system.

MR. AVERY: The resistance of the most uniform carbon which I have been able to maintain—and I have measured the resistance, I think, of almost every make in this country—is about one-third ohm, and the resistance of the same carbons copper-plated is about three hundredths of an ohm. There is a difference then between the copper-plated carbon and the plain carbon of three-tenths of an ohm per lamp. On a forty-lamp circuit that would make a difference which you can readily figure, and which I think would be quite an object, notwithstanding five lamps have a resistance as low as two ohms. I think it would be quite an item. Then one other point concerning plated carbons. The main portion of resistance in a copper-plated carbon lies between the end of the plating and the arc. The part where the current has to pass through, the unplated portion of the carbon, is the same when the carbon is short that it is when the carbon is twelve inches long. When you have one six-inch carbon the resistance is just one-half what it is when you start with the twelve-inch. We ought to get the steadiest light from a copper-plated carbon. Theoretically the resistance ought to be increased three-tenths of an ohm for each lamp trimmed with a black carbon. I do not know how it is practically.

THE PRESIDENT: The report of the committee on Permanent Organization closes the regular business of the Convention. We will now have the report of that committee as the next business in the regular order. Mr. Chairman, read your Report.

Mr. Hovey: Before reading the written report, on behalf of the committee, I want to say a few words giving a sort of a summary of the discussions which we have had. This morning prior to the first session of this Convention, we had a general consideration of the matter. In the interim I drew up for the committee an outline of a constitution, and after the session we had another meeting of our committee and put it into exact form. Our instructions were general and we assumed, inasmuch as the Convention here is drawing to a close, that it was desired we should practically complete the work and lay it before this Convention. Of course when it is before this Convention, it will decide what to do with it. We had as a basis to go upon, a copy of the Constitution of the National Telephone Exchange Association, of course changing it very materially, and adapting it to the wants of such an association as is here contemplated. We have also gone upon the idea that the less machinery such an organization has the better.

Article First: The name of this Association shall be the National Electric Light Association.

Article Second: The members of this Association shall be companies, firms or individuals operating electric light plants or manufacturing electric light apparatus.

Article Third: Companies, individuals or firms, engaged in the manufacture of machinery or apparatus connected with the electric light may be admitted to associate membership by vote of the Executive Committee; such associate members shall pay the same dues as members, and shall be entitled to seats at all meetings, but shall have no vote; they shall be ineligible to office, and shall be entitled to the floor only at the request of the Executive Committee or the presiding officer.

Article Fourth: The officers of this Association shall be a President, three Vice-Presidents, a Secretary and Treasurer, who shall be one and the same person, and six members as an Executive Committee, of which the President, Vice-Presidents and

Treasurer shall be members, *ex officio*. Five members shall be a quorum. All officers shall be elected by ballot at each annual meeting of this Association, and shall hold their respective offices for the term of one year, or until their successors are elected and qualified.

ARTICLE FIFTH: The duties of the several officers shall be those usually pertaining to their offices.

ARTICLE SIXTH: The Executive Committee shall be the governing body of the Association. It shall meet from time to time, gather and prepare information on all topics of interest, and submit reports at each meeting of the Association.

ARTICLE SEVENTH: At least one general meeting of the Association shall be held each year at such time and place as the Executive Committee shall determine.

ARTICLE EIGHTH: The entrance fee shall be ten dollars for each member, and the annual dues ten dollars. Each member may be represented by a member or delegates, not exceeding three, who shall be entitled to one vote.

This Constitution may be amended at any general meeting of the Association by a vote of two-thirds of those present.

We came, of course, at the outset, to the consideration of the question as to who shall be the officers, and as an additional part of our report, we submit, with all diffidence, the following list: President, J. F. Morrison, Baltimore; Vice-Presidents, H. W. Cleveland, of Hartford; J. H. Yarborough, Nashville; E. R. Weeks, Kansas City; Secretary and Treasurer, W. A. Hovey; Executive Committee J. B. Fletcher, Dayton; G. S. Bowen, Chicago; W. Hochhausen, New York; Gilbert Donaldson, St. Paul; Frank Ridlon, Boston; J. O'Connor, New Orleans. All of these gentlemen are present and took a part in this Convention, except Mr. O'Connor, but we felt desirous to have a gentleman on the executive committee representing the far South.

On motion the report of the committee was adopted.

THE PRESIDENT: The next business in order is the nomination of officers. The nomination for the office of President is in order.

Mr. Hovey: The committee nominates J. F. Morrison, of Baltimore.

The President: Prepare your ballots for election.

On motion, Mr. Bowen was authorized to cast the ballot of the members present for President.

A motion was then made that the nomination be closed.

There being no objection, it was closed, and Mr. Bowen cast a vote on behalf of the Association for Mr. Morrison.

Mr. Hovey: Allow me to present Mr. Morrison, the distinguished President-elect of the new Association.

Mr. Morrison: We have no time for speeches; we have too much to do to get through the balance of the work of the Convention. The next business in order is the nomination for Vice-Presidents.

Mr. Curtis moved that the Secretary be empowered to cast a ballot for the nominations made by the committee, which was seconded.

Mr. Hovey: I will then cast a ballot.

The President: By the unanimous consent of this Convention, the Secretary will cast a ballot for the gentlemen whose names he will now read.

A motion was made that it be for the whole ticket.

The President: The motion is not in order. H. M. Cleveland, of Hartford; J. H. Yarborough, of Nashville; and E. R. Weeks, of Kansas City, are nominated for Vice-Presidents. By unanimous consent the Secretary will cast a ballot for the above named gentlemen.

Mr. Hovey cast the ballot.

The President: I now declare Messrs. Cleveland, Yarborough, and Weeks, duly elected Vice-Presidents of this Association. The next business in order is the election of a Secretary and Treasurer. Nominations are in order.

Mr. Weeks: I nominate Mr. Hovey.

On motion nominations were closed.

The President: If there be no objection, I declare Mr. Hovey unanimously elected Secretary and Treasurer.

Mr. Hovey: On behalf of the Executive Committee I nomi-

nate George S. Bowen, of Chicago; W. Hochhausen, of New York; Gilbert Donaldson, of St. Paul; Frank Ridlon, of Boston; John R. Fletcher, of Dayton, Ohio; and Mr. James O'Connor, of New Orleans.

THE PRESIDENT: The nominations are before you.

On motion the nominations were closed.

THE PRESIDENT: The Secretary will cast a ballot for the gentlemen named.

MR. HOVEY: I cast the ballot of the Convention for Messrs. Bowen, Hochhausen, Donaldson, Ridlon, Fletcher, and O'Connor.

THE PRESIDENT: I declare the gentlemen whose names you have heard duly elected as the Executive Committee of the Association for the ensuing year. Is there any business?

A motion was made to adjourn.

THE PRESIDENT: The motion to adjourn is made and is not debatable.

The motion was withdrawn.

MR. BOWEN: Mr. Chairman and gentlemen of the Convention, on behalf of the Committee of Arrangements of Chicago, who were organized for the purpose of facilitating the business of this meeting, I desire to express their thanks for the personal attendance of each gentleman here. Many of you have come many miles to attend this Convention. It certainly affords me great pleasure to come in contact with so much electric light. I trust, gentlemen, that the circuit which has been established may never be broken; that it may continue to grow and prosper, and that the electric light business in this country will grow with your growth and my growth. I know, gentlemen, that it is a great topic. I do not assume to enter into the discussion of it, but only to say I thank you all very much, personally, for your attendance here. Having said so much, I desire to offer a resolution: "That the thanks of this Convention be tendered to the Chairman for the able manner in which he has presided over the deliberations of this Convention."

I move the adoption of the resolution.

The resolution was seconded.

Mr. Bowen placed the resolution before the Convention and it was unanimously adopted.

THE PRESIDENT: Gentlemen, you have done me a great honor, two honors; first, in electing me President of such a Convention as this, an honor any one may be proud of. I felt your kindness all through the proceedings of this Convention as deeply as a man could possibly feel it. Mr. Bowen has put the case to you plainly that your interests lie in the direction which you have marked out to-day. This is a broader scheme and more comprehensive than almost any one in this room, perhaps, thinks at this time. You have started an Association here which will enable you to do just what has been done from time immemorial. It will enable you to stand shoulder to shoulder to defend your rights. In the first place, it will give you a facility for knowing what your rights are that you never had before. It will give you an opportunity of communication between the different companies which the electric light interests ought to have had long since for combination. Now that is a dangerous word, and the combination I am talking about is not the combination of men who desire an unfair advantage for themselves at the expense of others. It is a combination which lies in their ability to understand and learn to work the details of their business, and protect them from the pirates who infest the electric light business, perhaps more than any other. It gives them an opportunity to protect those who protect them. It gives them an opportunity to make that sort of a combination. And it gives them the possibilities of such an intercourse as will save them from the stepfathers and the stepmothers of their parent companies. I observe the gentlemen representing some of the parent companies do not smile. Now as this Convention is drawing to a close, I return you my sincere thanks for the treatment you have accorded me as presiding officer, and when I say that, I mean all that it implies. I feel deeply grateful to you for your courteous treatment during your deliberations. The next meeting of this body ought to be held in July, and at some place where you will not be confined to one or two days, compelling you to crowd into this short time work which ought to take five or six days,—work hastily con-

sidered is not well considered. We have not had the opportunity to take up and digest subjects of so much importance to us which have been laid upon this table for consideration.

One other point, and I have done. That is, as you go from this Convention to your homes, that you yourselves watch the working details of your business, and hold to a strict account your engineers and superintendents, that they may furnish you every change, however unimportant it may appear, that takes place in the working details of your business, and communicate the same to this organization. That will give you the power I spoke of in this combination. If you do that, the whole story is told, and when you meet again, instead of sitting around this room like "bumps" on a log, waiting for some person to make you angry before you make a speech, or ask you what you have in your mind, every man will come to the Convention with his brain teeming with subjects of interest to his brother members. That is one of induction merely. They must know the faces of their fellow members, and hereafter they will know something of their features, and in regard to the conduct of their business. (Applause.)

Mr. Wadsworth: I think, it is fit and proper to offer a resolution of thanks to the proprietor of this hotel for the conveniences and courtesy in extending favors to us, reducing the rates of their hotel to the delegates here. I also think, it would be proper to offer a resolution of thanks to the Press of Chicago for the very full and comprehensive manner in which they have reported the deliberations of this Convention. I would, therefore, offer such a resolution: That this Convention extend their heartiest thanks to the proprietor of the Grand Pacific Hotel for his kindness and courtesy, and to the Press for the very full manner in which they have reported the proceedings of this Convention.

Mr. Bowen: I will second the resolution, and, in seconding it, I desire to state that the proprietor of this hotel most cheerfully accorded all the facilities you have, without charge; and also desire to say that the local Press of this city have, in the most kindly manner, extended all the notices I have requested them to make in regard to this Convention.

The resolution was unanimously adopted.

MR. WEEKS: In the line of your suggestions, I would say that I have drawn up an analysis of the operating expense for electric light plants, copied from a book which I have for my own management of our own business at Kansas City. I have placed over 100 of these sheets upon this table, and it may be well for each representative to take one of these with him. It will be, probably, of assistance to every member getting data in such a way that we can compare, so that, when we meet again, Mr. Smith can say what the expense of his plant is, Mr. Jones can say whas his is, say what it costs for the expense of running arc lamps of two thousand candle-power one hour. If Mr. Smith finds it costs him five cents an hour, and Jones shows it costs him two and a half or three cents, Mr. Smith and Mr. Jones had better get together, and see just where Mr. Smith is wrong. I think this will be a step in the right direction. It may facilitate matters for all delegates to take one of these papers.

MR. BOWEN: I may be permitted to state that the Treasurer of the new organization is here, and will be happy to receive the annual dues of any of the gentlemen who feel disposed to hand them to him while he is here.

A MEMBER: I think there should be books open here for the reception of the names of parties joining the new Association.

THE SECRETARY: I will attend to that.

On motion, the Convention was declared duly adjourned, *sine die.*

Names of Gentlemen who Attended the Meetings of the Convention at Chicago, Ill.

J. Frank Morrison, Brush Electric Company, Baltimore, Md.
Summerfield Baldwin, Brush Electric Company, Baltimore, Md.
Theodore P. Bailey, Chicago, Ill.
A. N. Lane, Muskegon, Iowa.
R. M. Johnson, Hyde Park, Ill.
J. H. Yarborough, Nashville, Tenn.
R. T. Robinson, Providence, R. I.
A. L. Ide, Springfield, Ill.
H. M. Cleveland, Schuyler Electric Light Company, Hartford, Conn.
S. E. Locke, Schuyler Electric Light Company, Omaha, Nebraska.
S. S. Badger, Badger Electric Light Company, Chicago, Ill.
M. C. Bullock, Brush Electric Light Company, Chicago, Ill.
C. J. Richards, Racine, Wis.
F. S. Terry, Electrical Supply Company, Chicago, Ill.
J. H. Reid, Electrical Supply Company, Chicago, Ill.
W. L. Bush, Van Depoele Company, Chicago, Ill.
C. J. Van Depoele, Van Depoele Company, Chicago, Ill.
E. J. O'Beirne, Star Iron Tower Company, Ft. Wayne, Ind.
W. A. Knapp, Railway Telegraph Supply Company, Chicago, Ill.
W. T. Lewis, Thomson-Houston Company, Racine, Wis.
F. H. Angell, American Electrical Works, Providence, R. I.
C. C. Curtis, Brush Company, Cleveland, Ohio.
E. D. Libbey, New England Glass Company, Boston, Mass.
J. D. Robinson, New England Glass Company, Chicago, Ill.
George D. Fletcher, Van Depoele Company, Dixon, Ill.
Elmer A. Sperry, Sperry Electric Light Company, Chicago, Ill.
Edwin Place, Sperry Electric Light Company, Chicago, Ill.
Charles E. French, Cleveland Carbon Company, Cleveland, O.
R. J. Randolph, Rockford, Ill.
W. T. Powers, Grand Rapids Electric Light Company, Grand Rapids, Mich.
George W. Carter, Van Depoele Company, Jackson, Mich.
E. T. Keim, United States Electric Light and Power Company, Dubuque, Iowa.
C. B. Askew, St. Paul Electric Works, St. Paul, Minn.
Joseph Fleisheim, Electric Light Company, Menomonee, Mich.
George L. Crossman, Thomson-Houston Electric Light Company.
D. Jacobus, Van Depoele Company, Crookston, Minn.
E. M. Fox, E. Remington & Sons, Ilion, N. Y.
F. M. Mills, Thomson-Houston Company, Des Moines, Iowa.
E. R. Montague, Brush Company, La Crosse, Wis.
H. C. Adams, Holmes, Booth & Hayden, New York.
A. W. McLaughlin, Holmes, Booth & Hayden, New York.

R. L. McDonald, Jenney Electric Company, Ft. Wayne, Ind.
Vernon Bell, Western Electric Company, Minneapolis, Minn.
Harold P. Brown, Chicago, Ill.
William H. Beach, Olmstead Electric Light Company, Minneapolis, Minn.
T. P. Plumridge, American Carbon Company, Chicago, Ill.
W. M. Goldthwaite, Electric Light Company, Adrian, Mich.
A. L. Avery, Buffalo Electric Works, Buffalo, N. Y.
H. D. Stanley, Bridgeport Electric Light Company, Bridgeport, Conn.
W. A. Hovey, *Electrical Review*, New York.
C. W. Price, *Electrical Review*, Chicago, Ill.
G. W. Parker, Parker, Russell & Co., St. Louis, Mo.
L. M. Fishback, Parker, Russell & Co., St. Louis, Mo.
W. Hochhausen, Excelsior Electric Company, New York.
John C. Fyfe, Nee Bau Electric Light Company, Chicago, Ill.
William A. Hammett, New York Safety Steam-Power Company, Chicago, Ill.
Frank Stewart, Western Electric Company, Chicago, Ill.
Charles A. Brown, Western Electric Company, Chicago, Ill.
George S. Bowen, Elgin Electric Light Company, Elgin, Ill.
W. H. Boulton, Boulton Carbon Company, Cleveland, O.
George H. Wadsworth, Boulton Carbon Company, Cleveland, O.
E. R. Weeks, Thomson-Houston Electric Light Company, Kansas City, Mo.
A. K. Stiles, Van Depoele Company, Chicago, Ill.
W. A. Kreidler, Correspondent, Chicago, Ill.
Frank Ridlon, Brush Electric Light Company, Boston, Mass.
R. T. McDonald, Jenney Electric Light Company, Ft. Wayne, Ind.
C. C. Warren, United States Electric Light Company, Chicago, Ill.
W. J. Buckley, Excelsior Electric Light Company, Chicago, Ill.
E. M. Barton, Western Electric Company, Chicago, Ill.
John Young, Western Electric Company, Chicago, Ill.
C. C. Haskins, Western Electric Company, Chicago, Ill.
C. A. Carter, Ansonia Brass and Copper Company, Chicago, Ill.
W. P. Hathaway, Fuller Electric Light Company, Milwaukee, Wis.
W. F. Walworth, Manufacturing Electric Light Cross Arms, South Bend, Ind.
J. C. Neville, Manufacturing Electric Light Cross Arms, South Bend, Ind.
E. B. Palmer, Sperry Electric Light Company, Chicago, Ill.
H. L. Brintnell, Swift Electric Light Company, Saginaw, Mich.
J. H. Stanwood, Badger Electric Light Company, Chicago, Ill.
L. W. Slack, Pittsburgh Carbon Company, Pittsburgh, Pa.
Elisha Gray, Chicago, Ill.
H. W. Burgett, American Electrical and Illuminating Company, Boston, Mass.
G. Donaldson, Electric Light Company, St. Paul, Minn.
W. H. Keasel, Willoughby, Hill & Co., Chicago, Ill.
D. R. Russell, Parker, Russell & Co., St. Louis, Mo.
John R. Fletcher, Dayton Electric Light Company, Dayton, O.
C. H. Webster, Chicago, Ill.
J. D. Simpson, Chicago, Ill.

PROCEEDINGS

OF THE

NATIONAL ELECTRIC LIGHT ASSOCIATION,

AT THE

SEMI-ANNUAL CONVENTION.

FIRST DAY'S PROCEEDINGS.

UNION SQUARE HOTEL, NEW YORK, August 18th, 1885.

The Convention was called to order at 3 P.M. by the President of the Association, Mr. J. F. Morrison.

THE PRESIDENT: Gentlemen of the National Electric Light Association. It is now six months since our last meeting. During this time I have no doubt you have all given some consideration to the subjects partially discussed at that meeting, and have come here prepared to discuss them in even a more intelligent manner than they were then discussed. I will take up only so much of your time as may be necessary to name the different subjects which will be presented for your consideration, and to present to the Association for its action, some matters of change in the Constitution, which have been made necessary by reason of the resignation of the Secretary and Treasurer. Among the subjects for discussion will be that of the proper insulation of lines; the feasibility and cost of underground wires for electric purposes; the comparative desirability of the tower system of lighting,

with that of lighting from poles; the comparative cost of producing electric lights by steam and water power; electric motors and their relation to electric lighting in the producing of power; the best form of dynamo; and the advantages of electricity over other illuminants for street lighting. Major Heap, of the United States Lighthouse Board, will address you on the subject of electricity for lighthouse purposes. I presume that, during the session, various matters will come up which will attract the attention of the members of this Association and will be properly discussed. There is one thing which, perhaps, it is better to warn you of ahead, if that term is admissible. An effort will be made during this Convention to establish business relations between the different working companies; that is to say, to have such relations as will lead to the establishment of a uniform price for electric lighting in the different parts of the country, and that without regard to the system by which the electric lights may have been produced. At the same time and in that connection a like effort will be made by the consumers. (We propose to call the companies here consumers, as distinguished from the producer or manufacturer of lighting apparatus and supplies.) We propose to make an effort to bring about an equalization of the prices between the different manufacturers, so that instead of destroying each other, this Association may be the means of building up friendly relations between the different electric light companies of this country, and, perhaps, compel fairer play than you can coax out of what is known as the parent companies. That applies all the way down from the manufacturers of machinery to the manufacturers of carbon.

I declare the Convention now open for the transaction of business. The first business in order is the report of the Executive Committee.

Mr. G. S. Bowen: The Executive Committee had in hand the examination of the accounts of the Secretary and Treasurer, and report as follows: The amount already received for membership is $620, 62 names having been registered, and the dues having been paid. There have been also added since this report was made, the names of 3 other gentlemen. There have been ex-

pended $415.67, vouchers for which I hold in my hand, and which the Executive Committee has approved. I now move you, Mr. Chairman, that the report of the Executive Committee, so far as finances are concerned, be approved.

The motion was carried.

MR. BOWEN: These vouchers are subject to examination by any member of the Convention. I have no doubt they are correct.

It has been found very desirable to amend our Constitution in one or two particulars; and I have, as a part of my report, a resolution to change Article 3, so that it shall read after the words "electric lighting," etc., as persons eligible to membership, companies, individuals, or firms engaged in the manufacture of machinery or apparatus connected with electric lighting—"electricians, electrical engineers, or business collaterally connected therewith."

The object of making this change is that all persons interested in electric lighting, the manufacturer of electric apparatus, or anything pertaining to electric lighting, or electricity in any way, may become members of this Association. I suggest, Mr. Chairman, that this amendment may be made as proposed.

THE PRESIDENT: Gentlemen, the amendment is presented as the result of the action of the Executive Committee, and is now before you for your action.

MR. WADSWORTH: I move you, sir, that the recommendation of the Executive Committee be adopted, and that the Constitution be so changed in accordance with the recommendation.

THE PRESIDENT: The Secretary will please call the roll.

The roll was then called, and the amendment was adopted.

MR. BOWEN: It was discovered that Article 4 provided that the Secretary and Treasurer should be one and the same person. It has been decided by the Executive Committee to recommend a change in the Constitution, so that it will read that the officers of the Association shall be a President, three Vice-Presidents, a Secretary and a Treasurer, who may be one and the same person. It does not provide that they may be one. We, therefore, offer this resolution:

Resolved, That Article 3, line 5, be amended so as to read "may be" instead of "shall be" one and the same person.

The amendment was adopted.

MR. BOWEN: The Secretary has handed me the following, which I will incorporate in my report. It is the resignation of Mr. Baldwin as Treasurer:

"I hereby tender my resignation as Treasurer of the National Electric Light Association.

"Very respectfully,
"SUMMERFIELD BALDWIN."

On motion the resignation was accepted.

MR. BOWEN: The Executive Committee have very hurriedly put these little items in form as well as they could. Before another session we will have formulated a more correct report. I beg that you will pardon the informality, and will merely say that I am delighted, as the Chairman of the Executive Committee, to see so many gentlemen here, and I trust that the proceedings of this meeting will be full of interest and profit to all who have been kind enough to favor us with their presence.

MR. CLEVELAND: I understand that the Association is without a Secretary.

THE PRESIDENT: Without a Secretary or Treasurer.

MR. CLEVELAND: In connection with that I presume it would be preferable for the President that he and the Secretary should both be located in the same place, as there are a number of matters of business pertaining to the Association that require the joint action of both those officers. Now I would suggest that if the President of the Association know of some person in Baltimore who would be a fit person to fill that office, he suggest the name.

MR. E. R. WEEKS: Action has been taken according to the gentleman's suggestion. If any nominations are in order, I would nominate for Treasurer Mr. H. M. Linnell, and for Secretary Mr. H. E. Rheinhard, a fellow-citizen of our President.

MR. WADSWORTH: If nominations are to be made, I would nominate for Treasurer Mr. Charles Cooper, of Brooklyn.

Mr. Cooper: I would respectfully decline.

A member: Is this the annual meeting now, or is February the time the election of officers takes place?

The President: This is the semi-annual meeting. We are having an election only to fill vacancies.

Mr. Bowen: The Executive Committee considered it wise that the Secretary of this Association should be near at hand, so as to aid the President in any movement that he might desire to carry out, and we selected a gentleman who, the President of this Association says, is perfectly competent to act as Secretary of the Association, Mr. Rheinhard, of Baltimore. It has also recommended the name of Mr. Linnell, of Hartford, for Treasurer, for whom Mr. Cleveland vouches as being a very excellent business man, and there can be no question about his reliability in every sense. I, therefore, move you that those two gentlemen be elected Secretary and Treasurer of the National Electric Light Association.

Mr. Elder: I move that the action of the Convention be taken separately on the Treasurership and Secretaryship.

Agreed to.

Mr. Elder: I put in nomination for Secretary of the Association Mr. Martin, of the *Electrical World*. My idea in doing this is that I believe the position should be held by a person who is not pledged to this or that system; that the Secretary of the Association should be unbiased; that Mr. Martin is fully competent I think all will admit, and for that reason I put his name in nomination for the position.

Mr. Wadsworth: I would like to put in nomination Mr. Price, of the *Electrical Review*. I fully concur in what Mr. Elder has said in regard to the office of Secretary.

Mr. Price: I would like to say for Mr. Price, that he respectfully declines the honor. He thinks that if the recommendation of the Executive Committee is carried out it will be most satisfactory.

The President: Mr. Price declines. Mr. H. E. Rheinhard of Baltimore, and Mr. Martin of New York, are nominated for

Secretary. Mr. Martin is not a member of the Association. Mr. Rheinhard is.

A MEMBER: Is Mr. Martin eligible?

THE PRESIDENT: I think so. The National Electric Light Association is competent to select its Secretary from outside its own ranks.

MR. ADAMS: Do associate members have a vote in this matter?

THE PRESIDENT: No, sir.

MR. ADAMS: Only electric lighting companies.

THE PRESIDENT: Those are all.

MR. WADSWORTH: The representatives of private plants have a vote?

THE PRESIDENT: All those owning or operating electric lighting plants, have a vote.

MR. WADSWORTH: I would like to inquire what is the construction of the language "manufacturing electric light apparatus," in Article 2.

THE PRESIDENT: That means manufacturing apparatus to produce light.

MR. WADSWORTH: Carbon?

THE PRESIDENT: No, sir.

MR. WADSWORTH: Wire?

THE PRESIDENT: No, sir. That is not apparatus. That comes under the head of supplies. Dynamos and lamps are referred to.

MR. WADSWORTH: I represent a plant here, and as the representative of that plant I claim the right of an active member.

THE PRESIDENT: The question was raised and settled in Chicago, that Mr. Wadsworth has a right to a seat on the floor as representing a company owning an isolated plant.

The roll was then called on the vote for Secretary, and Mr. Rheinhard received 22 votes, Mr. Martin 8.

THE PRESIDENT: Mr. Rheinhard has received a majority of the votes cast, and is therefore the Secretary of the Association. The next business is the election of a Treasurer.

MR. BOWEN: I would offer an amendment, that Mr. Linnell be declared Treasurer by the unanimous vote of the Convention.

Mr. Wadsworth: Several objections have been raised by members of the Association to the election of Mr. Linnell. I do not care one way or the other about it myself, but the objection has been raised that Mr. Linnell is general manager of the Schuyler Company. Mr. Cleveland is President of the Schuyler Company and represents it in the Vice-Presidency of the Association. Some of these gentlemen who are operating other systems of electric lighting here, have felt that one representative of each system was enough, and they have requested me, as they are naturally bashful about this matter, to make this statement to the Convention. I would therefore move that Mr. Cooper be the nominee.

The President: I understand that Mr. Cooper declines.

Mr. Cooper: Under the circumstances, Mr. President, I will act. I do not like to go back on my friend Wadsworth.

Mr. Ridlon: I suggest that the election of Treasurer be proceeded with in some other way. The last method takes too much time.

Mr. Leggett: I notice that Article 4 requires that these officers be elected by ballot. I move, in order to save time, that the Secretary be instructed to cast a unanimous ballot for the Association in favor of Mr. Cooper.

The President: The gentleman is out of order. There are two nominations before the Convention which have to be settled by ballot. Are there any other nominations?

Mr. Cooper: I see that only at an annual meeting can there be an election of officers.

The President: This is an election to fill vacancies. At any meeting the Association has a right to fill an office when it is vacant. We are about to fill a vacancy.

Mr. Cooper: Is it not customary for the Executive Committee to fill vacancies?

The President: Not during the progress of the Convention. The resignations were received during the session of the Convention. Therefore the vacancy becomes the property of the Convention and must be filled by ballot. There are in nomination now Mr. Cooper, President of the Municipal Electric Lighting Com-

pany of Brooklyn, and Mr. E. M. Lindell, business manager of the Schuyler Electric Lighting Company of Hartford, Connecticut.

Mr. Wainwright: What is to prevent the motion being put that the Secretary cast the unanimous vote of the Convention for Mr. Cooper?

The President: Because the Secretary cannot cast a unanimous vote, from the fact that two members are in nomination.

Mr. Elder: Mr. Chairman, I appeal from your decision.

A vote was taken on the appeal, and the decision of the Chair was sustained.

The Secretary then called the roll on the vote for Treasurer.

The President announced that it was a tie vote.

Mr. Porter: Mr. President, I claim the right to vote.

The President: The ballot is closed. Your vote cannot be received now. There is only one person present who can give a casting vote, and that is the President, and I do not know whether he will give it or not. It will be necessary to take another ballot. I hope that the members will vote before the ballot is closed this time.

The balloting was then proceeded with.

Mr. Elder: Mr. Porter, who claimed the right on the last ballot to cast a vote, has not been informed whether he has a right to vote as a member of the Convention or not.

The President: He is an associate member and has no right to vote.

Mr. Elder: On what grounds?

The President: On the ground of his being an associate member instead of an active member.

Mr. Porter: What constitutes an active member, Mr. Chairman?

The President: You received your ticket as the representative of the Pittsburgh Carbon Company?

Mr. Porter: We own and operate a plant.

The President: It was not so stated on your ticket.

Mr. Cooper: I think that, with the explanation the gentleman has now made, he has a right to vote.

The President: The case will be corrected, and the gentle-

man will be allowed to vote as soon as he shows he is entitled to vote.

Mr. Elder: When does the amendment to the Constitution for which we voted in the early part of the meeting take effect?

The President: It has taken effect.

Mr. Elder: With all due respect to your ruling, I think that that amendment includes the gentleman from the Pittsburgh Carbon Company.

The President: The gentleman will please take his seat until after the counting of the ballot.

The ballot resulted in favor of Mr. Cooper.

The President declared that Mr. Cooper was duly elected Treasurer of the Association, and stated that the next business in order would be the nomination of Assistant Secretaries and a Sergeant at Arms.

Mr. Bowen: I move that Mr. A. J. Dam serve as Sergeant at Arms during this Convention.

The motion was seconded.

Mr. Cooper: Was the question of Mr. Porter's right to vote settled?

The President: No, sir. The question is on the nomination of a Sergeant at Arms.

Mr. Cooper: When will that question be settled?

The President: As soon as a vote is had on it. There being no other nominations and no objections, the Secretary will cast his vote for Mr. Dam as Sergeant at Arms.

The Secretary then cast the vote of the Association for Mr. Dam as Sergeant at Arms, and he was declared to be duly elected.

Mr. Duncan: I hope the question of Mr. Porter's right to vote will be settled.

The President: As soon as the matter is in order, it will be considered. The first thing in order is to get this Convention in working shape and get its officers elected. Now we must elect Assistant Secretaries.

Mr. Cooper: It hardly seems fair—

The President: The gentleman is out of order, and will please take his seat.

Mr. Cooper: I appeal from the decision of the Chair.

Mr. Bowen: I nominate Mr. Garrett, of Baltimore, and Mr. Stanley, of Bridgeport.

The President: If there be no objection, the Secretary will cast the ballot for the gentlemen named.

Mr. Elder: Mr. Chairman—

The President: There is a ballot in progress. Messrs. Garrett and Stanley are duly elected Assistant Secretaries for the present meeting.

Mr. Duncan: I move that Mr. Porter's name be placed on the roll.

The President: Now then, Mr. Porter will please state what plant he owns or operates.

Mr. Porter: A Brush plant for the purpose of making light.

Mr. Bowen: With your permission, I will read this dispatch:

Boston, Massachusetts, August 18, 1885.

J. F. Morrison, etc.:

I am extremely sorry not to have been with you to-day. My business called me here. Please to extend to the Convention my best wishes for its success, and the sincere hope that the deliberations will be wise and business-like, and calculated to render substantial aid to the efforts of manufacturers generally in placing the electric light business on a profitable and enduring basis.

Edward H. Goff.

Mr. Duncan: I move to amend Article 4 of the Constitution by inserting the following clause:

"The officers of this Association shall be a President, three Vice-Presidents, a Secretary, and a Treasurer, and six members of the Executive Committee, all of whom shall be members of this Association."

The amendment was adopted.

Mr. Duncan: I move further that the Executive Committee be instructed to prepare by-laws for the government of the Association.

The motion was adopted.

THE PRESIDENT: Mr. Porter's company is running a Brush plant composed of one lighting machine and operating one lamp. I would ask if this Convention considers Mr. Porter, under these circumstances, eligible to vote? Does Mr. Porter desire to press his right to active membership?

MR. PORTER: Yes, certainly.

MR. LEGGETT: I make a motion in advance, that the words "firms or individuals operating electric light plants," in Article 2 of the Constitution, be construed to mean only individuals or companies, or firms which are doing a lighting business with their plant, not for their own private purposes.

The motion was seconded.

MR. LEGGETT: I only thought that while it brings to us members that might be desirable in other respects, yet it is not forwarding the interests of the Association. I understand that companies manufacturing electric lighting apparatus, or firms, individuals or companies who are operating a central station from which they are supplying electric light as a business,—not for their own private purposes—these are the parties who are intended by the constitution to be active members.

MR. WADSWORTH: I hope this motion will not prevail, because, if it does, it will shut out from this Convention the representatives of every mill in New England. There are mills there operating plants of from one hundred to six hundred lights, and men operating a plant of that size certainly have a right to active membership here. It is desirable for the Convention to get them here. It is desirable for this Convention to hear from them the experience they have met with in operating those plants in cotton and woollen mills; and I know personally a great many of the representatives of those mills who are not only thoroughly posted in electrical matters, but who can give this Convention or any members of it valuable information in regard to operating electric light plants. They operate all the various systems of the United States, both arc and incandescent, and at our meeting in Chicago we held out inducements to them to come here. We formulated this Constitution with the understanding that they were to be represented, and I think at this late day it would be

entirely wrong to say they cannot come into it. They represent a very large number of lights, and they ought to be represented in this Convention.

MR. LEGGETT: I agree entirely with Mr. Wadsworth's views with respect to the desirability of having such individuals or firms represented in this Association; but it does not appear to me that they need to come here as regular members. The Constitution, if it is not already by amendment made broad enough to permit these parties to come in as associate members, might be so changed as to permit them to come in as such without a vote. We can then have the advantage of their presence, and they can have the advantage of the Association.

MR. WADSWORTH: In reply to that I would like to put this proposition before the Convention: You allow John Smith who is operating a twenty-five light lamp in Shawneetown to come in here and become an active member, and you bar out a representative of the Amoskeag mill, that operates 600 lights. Now it does not matter much to these mill men whether or not they are active members; yet it seems to me unfair to bar them from active membership. It will result in taking away a large fund from the Association. It will drive away mill men whom the different members of the Executive Committee have worked very hard to get to come here; and they represent a very large and important interest in the electric light field, and ought to be active members.

MR. DUNCAN: I think the amendment should prevail, for the very reason stated by Mr. Wadsworth in opposition to it. These mill men when they see this Association is run from a business standpoint, will then have some confidence in the Association, and will be glad to become associate members, and give us the experience of their training and their personal observation of their plant. But when they see that all outside interests, manufacturers of wire and everything else, may become full voting members in the Association, they will lose confidence in it.

MR. MORRISON (Mr. Cleveland, Vice-President, in the chair): Mr. Chairman and gentlemen of the Convention: When the question of forming this Association was first mooted at Chicago, this was one of the stumbling-blocks in the way. It was dis-

cussed fully and in all its bearings. The objection made there to the admission of such gentlemen as Mr. Porter and others, who are virtually dealers in supplies, and not electric light men, was just such as Mr. Duncan has gone over now. On the other hand, the business in which they are engaged is so closely allied to that of electric lighting, being a part of the electric lighting business itself, that it was very difficult to draw the line. The line was drawn, however, at this point—that a man who was a user of an electric light plant was entitled thereby to active membership in the Association; but it was understood that that electric light plant was to be of sufficient size to entitle him to some consideration amongst electric light men. In other words, that the questions that would arise in this Convention—or rather the result of those questions, and the discussion upon them—would be for the benefit of the men who operate electric light plants. Now I want to ask you if, a gentleman running a one-light Brush machine with one lamp, in a carbon factory, representing the carbon interests absolutely and entirely, he has sufficient interest in that one lamp at Pittsburgh to entitle him to be benefited in any way, so far as his electric light is concerned, by the discussions which take place in this Convention?

It was not the intention of the framers of this Constitution; it was not the intention of the Convention which adopted it; it was not the intention of the gentlemen who voted upon that Constitution, to make this Convention a Convention to advance the interests of men who dealt in electric light supplies. It was their intention that its beneficial results should accrue to those who were engaged in the business of electric lighting. But you will ask, why do you take the money belonging to these gentlemen—Mr. Porter's company and others? With a full knowledge on the part of Mr. Porter when he came into this room that he was only to be an associate member, he paid his ten dollars and received his ticket. In the hurry and bustle and crude form in which this Association finds itself, starting on its first step before the public, Mr. Porter sits in the Convention, and, when his vote is required by some one else, it is only then that he finds he is qualified to vote by reason of using a one-lamp Brush light. Now I assume that it is not the intention

of this Convention to depart from the principle it has adopted, to make it an electric lighting association. The information which the members of the Electric Light Association receive from the dealers in electric supplies makes it very desirable that these gentlemen should be associate members of this Association. The benefits which the dealers in supplies receive by being brought face to face, and directly in contact with the men who consume their articles, make it desirable for them to be associate members, and thereby recoup themselves for whatever expense they may have incurred to attend this Convention. I therefore assume that it is desirable on both sides to have the gentlemen in this business in this Association. I feel it is desirable; but it was believed proper and right to draw the line somewhere, and the line was drawn as I have endeavored to explain to you. I have no objection to Mr. Porter. I have no objection to the representative of Benedict & Burnham, who operate a plant of 36 lights, and who asks me, "Am I not eligible to active membership?" I said that that question would be decided when the case of Mr. Porter was decided. Now if this amendment to the Constitution prevails, you will not only cut off Mr. Porter and those applying for the benefits of active membership, but you will deprive gentlemen already holding active membership in the Association, of that membership. Now I ask you, is it wise to press the amendment? Was it wise to press an application for active membership under this Constitution? I claim that Mr. Porter's business is purely that of electrical supplies; that he has no interest in electric lighting other than his parallel interest in articles consumed in electric lighting. If Mr. Porter had a plant where he was employing an engineer to take care of his plant, it would be necessary to send that man here to give such information as might arise in the discussion. He runs one light. There is no information which Mr. Porter could carry home that he would apply to the light, but he would apply it to the carbon business. All these things make it unwise to force on this Convention a questionable right to active membership.

Mr. Fishback: I would like to know why Mr. Wadsworth is left on the other side of that line? Why is Mr. Wadsworth

interested any differently from those other carbon factories that have as many lights?

THE PRESIDENT: Mr. Wadsworth was operating a plant sufficiently large—this was the representation at the Chicago meeting—to make it desirable for him to seek information, and to carry it home, as regards the economical method of running electric lights; not to apply it in his business of carbon dealer, but to apply it in the electric light part of his business. Mr. Wadsworth was an active member of the Association, elected as such at Chicago, and he carries his active membership here. If the amendment proposed by Mr. Leggett prevails, Mr. Wadsworth ceases at once to be an active member.

MR. FISHBACK: At the Convention at Chicago our claims were made and recognized. Yet to-day, in calling off the names, our company was omitted from the list. I intended to press the matter in a quiet way; but as long as it has been brought up, I would just like to know the reason; that is all. We are running a plant which is, I think, equally as large as the Boulton Company's, and we use it to light our factory at night.

MR. COOPER: In order to get around this difficult question, I will move an amendment to the second Article of the Constitution, so as to read, "The members of this Association shall be companies, firms, or individuals, operating electric light plants for rental, or firms or individuals using at least 50 arc lights, or 350 incandescent lights."

The motion was seconded.

MR. WADSWORTH: In reply to the question of my friend, Mr. Fishback, I would simply say, that when I became an active member of this Association, I said I represented a plant. I do. I represent 35 lights composed of about four different systems. Now, so far as myself being an active member of this Convention is concerned, it is immaterial to me. It would make no difference to my business, whether I am an active or an associate member; but, in the interest of other men, whom I know to be largely interested in this electric lighting business, men who have two dollars invested in this business for every one invested by a great many members on this floor—I say that it is wrong that we

make false promises in order to get men in here representing certain private plants. If we pass this resolution depriving them of active membership, they will not come here again. The mills in New England, the mills throughout the United States, have hundreds of thousands of dollars invested in the electric light business. As a well-wisher of the electric light fraternity of the United States, and as a man who sees all the uses of the electric light from Portland, Maine, to the Gulf of Mexico, I will say that I have held out this inducement to each individual operating a large plant throughout the United States, that, if he would send his representatives here, we would give him ten times the value of the money he paid us, in information. Upon that representation, and the representation of other men representing electric lighting matters in New England, the mill men throughout New England send their representatives here. Now to tell them that they cannot come in here, I say is wrong. If you want to cut off the dealers, so far as representing isolated plants is concerned, if you say that any dealer or manufacturer of electrical supplies cannot become an active member of this Association, no matter whether he represents a private plant or not, there may be some justice in it. But there certainly is no justice in cutting these men off, who have ten thousand dollars invested, where a great many men here have not a thousand invested in the business of electric lighting. Personally, I do not care whether I am an associate member or an active member.

THE PRESIDENT: If I give the Association the result of Mr. Wadsworth's special pleading, it will, perhaps, throw some little light on the subject. After he, and the other gentlemen, have been engaged in advancing the interests of the Association throughout the United States, we have one mill represented in this National Association—one mill, that is the Riverside Mill. I do not think, therefore, that that will affect the result.

MR. LEGGETT: I hope the amendment of Mr. Cooper will not prevail. I think the line should be drawn just where it was originally intended that it should be drawn, *i. e.* to rule out companies who are simply operating private plants from active mem-

bership, and to include in the Association just what was doubtless originally intended to be included—companies, firms, or individuals, who are operating plants for the purpose of furnishing lights, renting lights for private or public purposes. Now, there is a reason in this. Take the action of our Executive Committee as reported to-day, upon the subjects for discussion before this Convention—the feasibility and cost of underground wires, for instance. What has a private individual, operating an electric light for his own purposes, or a mill having a private plant—what interest have they in a subject of that character? Now, take another subject—the advisability of tower-lighting in preference to pole-lighting. You might take each subject that was named by our President to-day. Every one relates to that kind of matter which pertains to public lighting plants. Now it is a matter of very great concern to the lighting companies in this country to know about these things, and to organize themselves together into an association; and it seems to me, that on matters which require a vote, on measures to be adopted, that those companies should not be trammelled in any way by the votes of parties or individuals or firms or corporations, which are not interested in this matter of public lighting or renting electric lights. All these gentlemen are welcome here. They can get their ten dollars' worth of information. This Association invites them to speak on a certain subject. They are present to be heard and they are present to hear. They can get all the information they seek, and we can get the advantage of their experience. But when it comes right down to a vote upon matters which affect our interests as parties who are renting electric lights, as parties who are governed by municipal legislation, required to go underground, and required to go over ground; as parties interested in tower- or pole-lighting, when we are to have ourselves subjected to a vote by a party who has no interest in those things, no interest in common—that is, in those respects—it seems to me it is out of place. Now, I do not know that this Association is exactly limited to the United States. I do not know why, under our Constitution, a Canadian or English company might not be represented here. We are very apt to have a very

large membership, and if we open this to every individual who is operating more than fifty lights, why we will be so flooded with individuals who have no interest in the matters at stake, that we will become unwieldy, and will be unable to transact our business. No disrespect is intended towards these parties. We can get information from them without their being active members, if they are here as associate members. I think, therefore, in this first move of the Association, when it comes to a matter of putting ourselves on a proper foundation for business, that we ought to be guided by no sentiment. We ought to draw the line clean and sharp. I hope, therefore, the amendment of Mr. Cooper to my amendment to the Constitution, which provides for letting in the companies operating more than a certain number of arc or incandescent lights, will not prevail; and that the amendment will be adopted to the effect that it shall be limited to persons, firms, or corporations, who are operating lights, renting them to private or public consumers, and engaged in the business of manufacturing electric light apparatus.

MR. COOPER: I withdraw my amendment.

MR. WADSWORTH: I would like to ask why the manufacturers of electric lighting apparatus are not excluded? If you are going to exclude manufacturers of other supplies, why not exclude them? I would like to ask that as a matter of information.

THE PRESIDENT: Perhaps Mr. Leggett can answer that question. I know no reason why they should not be excluded.

MR. LEGGETT: I would say simply this, that we are dependent on that kind of thing. That comes right home to us. It is not so necessary with carbons. Carbon is in the nature of supplies, but when we come to purchase our original apparatus, when we want the thing made in this way or that way, those are the people who ought to be among us.

MR. WADSWORTH: If there is any way by which you can operate an electric light plant of any kind without wire, carbons, or dynamo machinery, I would like to have the gentleman

explain it, and upon that I would like to know why not exclude the manufacturers of electric light?

MR. COOPER: I think the point of Mr. Wadsworth is well taken. I think it would be well to exclude manufacturers of dynamos.

MR. POOR: I move that the Constitution be amended so as to limit the active membership to those who make electric light for public sale only.

The motion was seconded.

MR. BOWEN: I agree most cordially with Mr. Wadsworth, in the idea of putting a liberal construction on the membership of this Association. In my judgment, we need the moral and pecuniary support of every man who operates an electric light. There are very few men operating electric light plants who cannot give us some information that would be valuable to us. With that thing in mind, I move that the whole subject be laid on the table, and that the Constitution remain as it now is.

The motion to lay on the table was lost.

THE PRESIDENT: The question is now on the amendment proposed by Mr. Poor.

MR. KING: I would propose that this matter be referred to a judicious committee of three (of which I shall not be one), to report to this Association at some future time. It does appear to me, sir, that this is a very important matter. I look upon this as an Association, calculated to advance the interests of the electric lighting of the world. I believe, sir, that it can be such an Association. If you admit all without any regard to their knowledge or attainments on the subject of electric lighting, you will have a large, unwieldy Association. If you limit the active membership to those who are actively engaged in the important matters of manufacturing plants, you will then be able to keep it in strict bounds. Is there any one here, that would pretend to say that any gentleman who is interested in electric lighting, would not receive the value of ten dollars a year? I think not. I think that the man who is engaged in running a very few lights will get a great deal more than his ten dollars. For my part, I do feel an interest in lights, as you well know,

and it was with a great deal of pleasure and anticipated information that I came here, and I yet expect to hear a great deal, and to be amply repaid. Therefore, I make the proposition to refer this matter to a committee of three, in order that it may be presented at some future time.

The motion was seconded.

Mr. Cooper: I would like to know why this Convention cannot decide these questions as they came up, and not refer them to a committee.

Mr. King: A committee, having heard those present, has heard all that has been said on the subject, and I think that a judicious committee could take all they have heard, and recommend something to the Association that would be acceptable to all.

Mr. Leggett: I would like to ask if he offers that as an amendment?

Mr. King: I offer that as a substitute.

Mr. Leggett: I would like to ask, whether an amendment to an amendment, or a substitute to an amendment, is in order?

The President: Absolutely, until the question is passed to the third degree. You are now to vote on Mr. King's substitute to Mr. Poor's amendment.

A vote was then taken on Mr. King's substitute, and the result being in doubt, the President called for a rising vote.

Mr. Poor: I rise to a point of order. This affects the manufacturers who are not entitled to vote.

The President: Under the present construction of the Constitution, they are entitled to vote.

Mr. Poor: It is a principle of parliamentary law that no one who is personally interested can vote.

The President: This is to refer the matter to a committee.

A rising vote was then taken, and it resulted in the adoption of Mr. King's substitute.

Mr. Cooper: I appeal from the vote, on the ground that there are more in the room than voted.

The President: In order to save the time of taking another vote, I will say to the gentleman that the highest vote had here was on the vote for Cooper and Linnell; fif-

teen votes for Linnell, and seventeen for Cooper; thirty-two altogether. The aggregate vote on this subject is thirty-one.

MR. COOPER: I saw one or two members who represent the same concern, voting.

THE PRESIDENT: I will call the roll on the appeal of the gentleman.

The roll was then called by the Secretary. Eighteen voted aye, and nine, no.

MR. COOPER: Will the Chairman appoint that committee later in the day, before the Convention adjourns?

THE PRESIDENT: Yes, sir.

MR. CLEVELAND: I move that when this Convention adjourns this evening it adjourn to meet at 10 o'clock to-morrow morning.

Agreed to.

THE PRESIDENT: The Chair will appoint the following committee to which the subject of the amendment to the constitution will be referred: Cooper, of Brooklyn; Leggett, of Detroit; and Weeks, of Kansas City.

On motion the Convention adjourned.

SECOND DAY'S PROCEEDINGS.

August 19th, 1885.

The Convention was called to order at 10 A.M.

The President called for the report of the special Committee on the Amendments to the Constitution.

MR. LEGGETT: Mr. President, the members of the committee having that matter in charge respectfully submit the following amendment to Article II. of the Constitution as a substitute for that section:

"Members of this Association shall be persons, firms, or corporations engaged in the lighting business, to wit, that of supplying electric lights from a central station to public or private consumers, as distinguished from such as are operating private plants, or engaged in the manufacture or sale of electrical machinery, apparatus or supplies."

In coming to this conclusion, we considered very carefully the

relation between the manufacturers and the members of the Association. It is very desirable to have them present, and, at times, to hear them. Section IV. provides clearly for their presence at the meetings of the Convention, and for their being heard when they desire to be heard, or for hearing them when the Convention desires to call upon them for their remarks. But in the business of the Convention we deem it advisable to draw the line between lighting companies and manufacturing companies. We thought that would be a better way, that it would facilitate business, that it would do away with a great deal of wrangling, which is the necessary result of bringing competing companies into a Convention of this sort; while it allows them to represent their interests, and us to hear them.

Mr. Cooper: The chairman has omitted to state in regard to a parent company operating a local plant.

Mr. Leggett: Where there is a parent company engaged in operating a local plant at any point, for the renting of lights to provide public consumers, they would be, of course, entitled to admission under the Constitution, as representatives of that plant.

On motion, the amendment to the Constitution was adopted.

Mr. Leggett: Now, Mr. President, I would suggest, in Article III., the change of one word. It reads, relative to associate members, that they shall be entitled to seats at all meetings, but have no vote; shall be ineligible to office, and "shall be entitled to the floor only at the request of the Executive Committee, or the presiding officer." I would suggest the change of the word "request" to "consent," so that the party may ask to be heard on the floor, instead of being requested to be heard.

The amendment was, on motion, adopted.

Mr. Weeks: I move the adoption of another article to our Constitution to this effect:

"Applications for membership shall be made to the President, and by him shall be referred to the Executive Committee."

The motion was seconded.

Mr. Cooper: What action will be taken by the Executive Committee? You say "referred to the Executive Committee" —for what? It seems to stop right there.

The President: For their approval.

Mr. Cooper: I make an amendment to that, Mr. President. After the words "Executive Committee" add, "and they shall have power to act thereon."

The amendment was accepted by Mr. Weeks, and the original amendment with this addition was adopted.

The President: The next business in order is the report of the Executive Committee on By-laws.

Mr. Bowen: The committee asks further time.

The President: The next business is the proposition that "The electric light is superior to other illuminants for public and private lighting," on which Mr. George S. Bowen will speak.

Mr. Ridlon: One moment, Mr. President; I desire to offer the following resolution:

"*Resolved*, That a committee be appointed to consider the question of maintaining, by the several manufacturing and lighting companies, a uniformity of prices for electric lighting apparatus and service."

The motion was seconded.

Mr. Cooper: I think it would be very hard to get all the manufacturers to agree to a uniform price on their apparatus.

Mr. Duncan: I move to lay that resolution on the table. I do not think we have any right to fix prices for persons who manufacture.

Mr. Weeks: It is not proposed in this matter to take any definite action upon it. It was the intention of the Executive Committee that this committee be appointed to look into the matter, to confer with manufacturers in regard to establishing standard prices, and see if it would be practicable, and also to do something toward establishing among sub-companies, uniform charges for service as far as local circumstances would admit. This is just a committee to investigate this matter and report to the Association at its next Convention. It seems to me that this is a field which should be explored, and all of us who are engaged in the practical operation of the plant have had occasion to think about this matter, when some of our brothers have spoken to us about other plants. Now, it seems to me that this

is a matter of great moment to the Association, and we ought to appoint this committee, and have them investigate the matter thoroughly, and make a full report to us at some future convention. I think we ought to put the matter through, and appoint upon that committee, men who will urge it with strength, and will investigate it thoroughly and give us a full report.

MR. SPERRY: I heartily concur with the last speaker. I, personally, have met this point in Chicago. The owner of a business renting out lights from a station, will come and tell you that he has been to New York, and that certain figures are there charged for the rental of electric arc lamps. They are always about half the figures that we charge in Chicago, and an investigation personally made by me since arriving in the city here, shows that they are false, and I think that an investigation into this matter by a committee would be a helpful thing for us all.

MR. RIDLON: The appointment of this committee would have some little effect in stopping a general slaughter of prices, *i.e.*, getting electric lights down to very much less than what it costs to produce them. The price should be whatever is fair play in the locality where the light is produced, according to the expense of producing it. That committee could certainly render valuable information to the Convention at some future time.

MR. CLEVELAND: Of course, the committee cannot get the electric light manufacturers, or men who sell electric lights, to establish a given tariff of prices, because circumstances vary both in the manufacture and the service. Now this question really illustrates the community of interests that ought to exist between the manufacturing companies and the sub-companies, because you cannot have a sub-company unless you have a manufacturing company, and a manufacturing company is good for nothing unless you have a company to use the apparatus. Now Mr. Ridlon and Mr. Weeks have both touched the marrow of this question, which is, that there ought to be such good fellowship among the manufacturing companies of the country, as that the territory already occupied should not be demoralized by competing companies. I mean by that, that when a respectable com-

pany is running an electric light plant in a place, large or small, giving good service at a fair price, it is not fair for another manufacturing company to go in and demoralize the market for the selling of light; putting in low bids; making valueless the stock of the local company that has been already created. Now my experience about it is that the field is very large for electric lighting. I think that all the manufacturing companies of the country who manufacture a good system, should have all the privilege they want, and I say, what this Association ought to do under that resolution is, to try to create such a sentiment among all the gentlemen who are connected with electric lighting, whether as manufacturers or as consumers, that there shall be fair play and courteous business relations between the different interests of electric lighting. Now, I would say for one, that the company with which I am connected does not propose to go into the cut-throat business that my friend, Mr. Ridlon, refers to. We are not overrun with business, although we are very busy, but we propose to take virgin soil so far as we operate in electric lights. We have been invited over and over again to go into a contest in several places where there are men who are a little disgruntled about the light, or the manufacture of it, or something of that kind, and who come to us and say: "There is a chance; we will get up a company for you; make low prices to start with, and we will root the other fellows out." We say: "No, we do not want it; we want to go where they want us to come; we want to treat everybody fairly, and we want to have every other company treat us in the same way." Now, if we do that, what would we do for the sub-companies? Here is a local company that has been created; stock has been distributed among the citizens, paying a fair dividend, giving good service, and everybody is satisfied excepting an occasional grumbler. Now, for a parent company to go in and demoralize that business field is not fair play. It does not show a fraternal spirit, and I am very ambitious that the electric light business in this country, shall be considered just as honorable and just as important and prominent as any other business in the country, and that the gentlemen con-

nected with it are the best men in the country, men of honor, men of brains, men of energy, men of push. Now let us have good fellowship and treat each other fairly; do as we are done by; manufacture our goods; organize our local companies and go on—not like the Goddess of Liberty enlightening the world, but enlightening our own country from corner to corner, from centre to circumference; treating every man fairly, and making our electric properties, parent stocks, and local stocks just as desirable investments as anything that you can find in Wall street.

The motion to lay on the table was lost. The resolution for the appointment of a committee was then put and carried.

MR. BOWEN: I suggest that the committee be appointed by the President at his leisure.

MR. RIDLON: I move that the committee consist of one representative from each system represented in the Association.

Agreed to.

THE PRESIDENT: Mr. Bowen will now address the Convention on "The Superiority of Electricity over other illuminants for Public Lighting."

MR. BOWEN: At a late moment, after the subject had been formulated for discussion, the President put my name at the foot of this question for a few remarks. I have been so much occupied with other duties that I have had no time for the preparation of any matter, and can only say, very briefly, what I have to say on that subject. When we come to take into account the question of the superiority of the electric light, it is so large a subject and of such great importance, that really it ought to be dealt with very carefully. Whoever speaks upon that should have good opportunity for preparation, so that the statements he makes be made with care and precision. You all know very well that in the public lighting of cities, as well as in the lighting of large business houses and hotels, there is and has been always a great waste of light. It has been produced at great expense, and if anybody will take the trouble to compare the measure of light they get now from the two-thousand power

or standard arc lamp, it will be shown that no light is produced so cheap, at so small an expense, and that will bring so desirable results, as the arc lamp. For subdivision and for the internal lighting of houses etc., of course incandescent lights are much more desirable and preferable. I look forward to a day, not very far distant, when all of our cities will be lighted by electric lights. It seems to me there is nothing so economical, bringing such good results, and so satisfactory to all cities and towns, as the electric arc light. Of course, in my experience, in very many cities I have heard a great many objections raised to arc lighting. It makes shadows and all that sort of thing, and there are many expressions in opposition to it. It would be very interesting if we could have them all written down, just to see the views that have been expressed in cities in regard to the introduction of something that is in opposition to the present custom of using gas. You all understand that any innovation meets with more or less objection, and, certainly, so far as electric lighting is concerned, nothing could be more bitterly opposed than that has been by gas interests, which, of course, are moneyed interests, and when they think there is an interference with the dividends of their money invested, they are opposed to electric lighting. I may state, as a fact which I am cognizant of, that in a western locality there are five or six little gas companies that have formed a syndicate, and they have one man who represents them. They are a committee of the whole, and whenever they see any little paragraph which is detrimental to the electric light, they have it printed and published in all of their local papers, and paid for by the syndicate as an advertisement. If it should happen that a New York newspaper stated, as I have seen it stated at one time, that a fire was caused by an electric wire, why it goes all over the country, and it is paid for by this local syndicate of gas interests. And it has occurred to me that it might be well for the electric lighting interests, perhaps, to combine with a view of showing how many hotels are blown up, and a great many other accidents brought about, by explosions of gas, and how many people have gone to sleep in these different hotels, and have waked up in the morning ready for the undertaker, simply because they did not

turn out the gas. Why, we could make a Bibleful of these things; they are every-day occurrences. I believe every city, every congregation of cities, all over the country, where there are a thousand or upwards, will, within a very short time, have their public lighting all done by the electric light. Of course, the various arrangements of the light will be hereafter considered. Just so far as the prime measure is concerned, that is, the superiority of that light over any other, I think there can be no possible question. Of course, electricity is a great subject, one that is so full of interest that when one begins to consider it, he is almost lost in the wonders that are being produced, and that will be produced, in that great force. Without taking up much of your time, I may say I was riding a few days ago in the cars, and I took out my little tablets, and inasmuch as I did not have any time to write anything for the present occasion, if you will indulge me, Mr. President and gentlemen, I will read these few words which I wrote, and which show the comparison between the past and present. It might be proper to read what I have written here, although when I wrote it I had no thought of this meeting.

There stood side by side in the recent Electrical Exhibition at Philadelphia, two telegraphic instruments, one the original, used by Prof. Morse to send that first inspired message from Washington to Baltimore; the other, the latest triumph in telegraphy, a synchronomic multiplex machine, by which an operater can [illegible] the same time send 72 messages—over one wire. To-day 1[illegible] men are required to light and extinguish the gas burners in [illegible] in the city of Chicago, at a great expense. The entire city of Elgin is illuminated in an instant, by simply turning a switch at no expense or loss of time, and Chicago, with its 600,000 citizens, might be lighted in the same manner. My first visit to the west in 184[illegible] [illegible] by slow stages over the various lin[illegible] [illegible] R.R., by the steamer May[illegible] [illegible] the State of Michigan [illegible] [illegible]d thence by steamer [illegible] time; we make the [illegible] entire distance in [illegible]

hours—meals on board. I predict that within five years, we shall make the trip from New York to Chicago—moved by that unseen and wonderful force, Electricity, in ten hours, breakfast in New York, tea in Chicago! Within twelve months, trains will be run between the electric cities of St. Paul and Minneapolis,—ten miles—in ten minutes! The growth of these two cities has been marvellous, but the wildest prediction as to their future will be more than realized. The great wheat fields are being extended by brainy men, and the country is crowding the city, to still greater and greater efforts. Twenty years from now these two corporations will embrace a population of more than 500,000 active, energetic inhabitants, worthy the place in which they dwell.

My first letters to my girl cost me ten cents, and many days passed before an answer came. Now, I send a message of twenty words a thousand miles for twenty cents, and get an answer in sixty minutes. Fourteen days was a quick trip across the Atlantic, now we make it in seven. Formerly, an entire day was spent in printing a single issue of a weekly paper, now, we print 60,000 copies of one of our great daily papers in an hour. At the National Exposition, I saw them pick the cotton in the morning, gin, card, spin, weave, color and make it up into a suit of clothes, which Gov. Colquitt wore in the evening. When Dr. Thomas and Prof. Swing expressed some doubt as to the temperature of Hades, and questioned the truth of some of the mystical dogmas of the Thirty-Nine Articles, they were both expelled from their various communions. Now, each of these eminent and popular preachers discourse to immense congregations in Chicago every Sunday morning. When Franklin succeeded in his efforts to control the lightning with his kite, the goodly people of Philadelphia thought him possessed of evil. Now we cook our tea, run our sewing machines, operate railway trains, light our Hell Gates and our great light houses, send messages around the world, heal the sick, print our newspapers, make our homes and business places cheerful, and by its beautiful and brilliant effulgence, illuminate our cities and villages, and yet we have only commenced the utilization of this subtle and wonderful force, that cannot be analyzed

by the chemist, dissected by the surgeon, or weighed by the grocer. The trustees of a southern college have voted to close its doors and dismiss the professors unless they will agree not to mention the word "Evolution." Only a few years since, America boasted of holding 4,000,000 slaves—now the census gives a population of 54,000,000 American citizens, the proudest title that can be desired. What shall we do with our brains? Let them rot? I say No—give us *more* and *better brains*, give us the opportunity of attaining the highest civilization we can enjoy, give us sound and healthy bodies, give us no more darkness, but give us light! more light! give us the electric light! It is the poor, as well as the rich man's light. It will light the suburbs as well as the central portions of your city. It is in fact the light for all. That it is infinitely superior to any other illuminant known, there is or can be no question. That it is more economical than any other system in use for general illumination, has been most clearly demonstrated, and the most exacting tests show that where candle power is considered, the electric light has no peer, either as regards its illuminating power or its actual cost. We have no quarrel with our gas friends, we want gas to cook our food, warm our houses, generate steam for our factories, illumine our houses, besides many other uses. There is a great future for gas; but for lighting our cities, opera houses, stores, railroad depot yards, churches, lecture rooms, manufactories, etc., the electric light has come, and come to stay.

THE PRESIDENT: Mr. A. F. Upton, of Boston, will address the Convention on "Steam power in reference to Electric Lighting."

MR. UPTON: Mr. President and gentlemen: My remarks to-day will be more particularly directed to the construction of central stations for arc and incandescent electric lighting. The first introduction that our company (the Jarvis Engineering Company) had in regard to electric lighting, was made in the city of New York, in the first central station that was ever [illegible] in this country, of the Brush system. That was followed [illegible] Harrison's company, the Brush Electric Light Company [illegible] by the Brush Company in Albany, and afterward [illegible] Since then we have completed

and thoroughly equipped all but three of the central electric lighting stations in New England, and completed and partially equipped stations all over the United States. We have stations in California, and, in the Southern States, in Mobile, and Norfolk, Virginia, also in Canada, Newfoundland and Peru.

The principal thing to my mind, in regard to electric lighting, is the cost of power. I have always claimed, from our experience, that the matter of power, in this regard, was figured, in one sense, on a wrong basis. My idea is, that to get at the bottom of all economy in electric lighting, the cost of power should be most carefully looked at. The only thing to be considered, is the actual cost per lamp per hour, not evaporation, or pounds of coal per hour.

It is the actual cost of running an incandescent or an arc lamp per hour. The first question naturally to arise in regard to this would be fuel. *In selling light, you are selling power;* that is one thing always to be kept in your mind.

The only money to be made in the future in electric lighting under the coming competition is to be made in saving. Reduce the cost of fuel, use only the cheapest and lowest cost grades. Why use the highest cost coal when slack coal, screenings, or pea coal can be purchased at one-half price, and with the proper furnaces evaporate the same amount of steam as the high cost grades? In carrying out that line of argument, I propose to state our experience. Believing that electric lighting had come to stay, we devoted all our energies toward getting up the most economical electric light plants. We decided to use direct acting engines, that is, direct belting, in preference to long stroke engines with long lines of shafting. That was our experience in watching several stations at the start, and in the stations that we subsequently equipped we adopted the Armington and Sims engine, belting direct to dynamos. In regard to boilers we have finally settled on using a plain steel tubular boiler. The size we are generally putting in now is $6' \times 16'$ with 140 three-inch tubes, giving 120-horse power. This size boiler, in one station we erected, is running two 60-horse power Armington and Sims engines furnishing 180 Thomson-Houston arc lamps. At the Edison station in Brockton, Massachusetts, we have indicated the

engines running with a boiler of this size, and they show 150-horse power duty, with 80 pounds pressure of steam. We have run at this station between fifteen and nineteen hundred 10- to 16-candle power lamps of the Edison system. We used cheap fuel. In a test taken with a sectional boiler along-side of it we showed an economy of 22 per cent. over using bituminous coal. The principal point we have made in regard to fuel was the utilization of all kinds of cheap fuel, such as screenings, soft coal, cinders from locomotives, sawdust, cotton-seed waste, rice chaff, etc. Anything that is combustible, whether wet or dry, we have used to good advantage. We have taken great pains to obtain figures from electric light companies. In some cases we have obtained them, in others we have been refused. There seems to be a reluctance among people to tell the cost of running. But the lowest price we have obtained is from the Thomson-Houston company in Lewiston, Maine. They are running at a fuel cost of two mills per lamp per hour, using sawdust fuel. I found that the average cost on stations we have fitted up has been, using screenings and soft coal and running arc lamps, about four mills per lamp per hour. The cost of running incandescent lamps I have not been able to obtain.

A test is now being made at the Edison Company station, in Harrisburg, Pennsylvania, where we have fitted up four Jarvis furnaces under boilers, to burn screenings and slack coal at a cost of less than one dollar per ton. The Ide engines are used here for motive power. If one electric light company purchases its fuel for fifty cents per ton and another pays three dollars, the result will soon show in the profits. I have talked with a great many electric light people, and have tried to enforce my ideas, that it is not evaporation, but the actual cost of the day's or night's run that is wanted. In fitting up stations, I spoke of using direct belting engines. We found, in making several tests, that the power lost in driving shafting has been from 10 to 15 per cent. There are gentlemen in this Convention, who have run an electric light plant, in which it took 22½ per cent. of the power to run the shafting. There is a station in the city of New York, where they have been shut down two weeks at a time, on account

of the breaking of the shafting. This can never happen when direct belted engines are used. Another point is, that, in running direct belted engines, as a rule, not more than 100 arc lights are put on a circuit. Now, if these lights are run from one dynamo or one engine, and the engine breaks down, your whole system is disarranged. In fitting up stations, I simply propose to state what we use ourselves. We use Sheffield grates or National Rocking grates, and the National Feed-Water Heater, made in New Haven. Wherever we can use a steam damper, we do so, as the pressure is kept much more even, and we advise its use on all steam plants. We always fit every station with a Worthington or Deane steam-pump, and a Korting single-hand injector as an auxiliary feed. A steam-tube cleaner is very useful where bituminous coal is used. We set our boilers with the Jarvis Patent Furnace; this is a boiler-setting now in general use all over the country, but more especially in the New England States. It is the same principle as the Seimen-Martin Furnace for making steel. In a different manner, and on a smaller scale, we pre-heat air (oxygen), and discharge it over and back of the fires: thus utilizing and igniting gases generally wasted. The joining of hot air with gases creates a draft, and allows the combustion of low grade fuels that would otherwise require a blast to burn. Smoke is reduced to a minimum by this process. If the fuel is wet, it is an advantage when hot air is used. In all tests made, the water and coal were actually weighed on scales (not measured by a meter). In every well regulated boiler-room, each day's coal should be weighed, not guessed at. I do not wish to enter into the question of electric lighting; that is not in our line. We have been employed in fitting up the steam plants by most of the companies who have started central stations in the Eastern States.

I would like to speak of a new system that is now being introduced into the Edison company station at Lawrence, Massachusetts, where we have recently added two 90-horse power Armington and Sims engines to run this system of incandescent lamps. It is called the Municipal system. They will use four circuits of ten miles each, and light 500 lamps of 32-candle power. They furnish these lamps for $650 a month. Now this

may puzzle you, but it puzzles the local gas company still more, how it can be done. There is one thing occurred to me, I think electric light companies should take into consideration, and that is the letting of power. At this station a large number of motors are used which run all day. They use from half a horse power to five horse power. These motors are all employed, as I understand from the company, at a good profit and it has always seemed to me that every one should use its power in the day-time to run small machinery. You have it there and why not use it? In the Thomson-Houston station at Brockton, Massachusetts, the construction of the plant is so peculiar that I think I am justified in bringing it before this Convention. It was changed so that over the station a shoe shop has been fitted up. The shoe shop is run by the engines in the day-time, and they receive a rental for that power of $2000 a year. This is supplied by a 35-horse power engine. It does not require 35-horse power, because while one wheel of the engine runs the machinery in the shop, the other runs part of the electric light in the city. If all stations were built in this way, there is not one in the country which would not show a very handsome profit on the surplus power they might have in the day-time. Another point in regard to this station: there are two stations in the city, an Edison company started first, and afterward a Thomson-Houston arc station. After the incandescent station was introduced, the sale of gas increased largely, and after the arc station started, it increased again 10 or 15 per cent. Now the question is asked, how did the introduction of so many arc and incandescent lights increase the sale of gas? I can account for it in no other way, than when one store is lighted brilliantly by electricity, the next one has to use more gas. Our experience in New England has been, that every gas company has increased the sale of gas since electric lights were introduced.

We have had some experience in regard to electric lighting and water power in New England. As a rule water power has been entirely abandoned. The trouble has been that it is not reliable. In Manchester, New Hampshire, the water has been very low several times in the past few years. In Lewiston it has given out altogether at times, and the stations there are using steam

power only. I understand there is a very successful station i Rochester running by water power. In conclusion I will say tha any questions which may be asked I will be pleased to answer to the best of my ability.

Mr. Duncan: You said that the contracts were made for one year. Is there any objection to stating the basis upon which that contract was made?

Mr. Upton: I do not think I can answer that question. I think you would find out if you go home that way.

Mr. Sperry: This matter of cheap fuel in our Western country is a matter of vital importance, and I would like to ask what changes in the furnace are required to burn this cheap fuel?

Mr. Upton: It is done entirely without a blast. It is done by mixing, with all slack coal, or else three-fourths of anthracite and one-quarter of charcoal. The principle of the Jarvis on a smaller scale is the same thing as the Seimen furnace on a large scale. The air is discharged over the fire, and is heated in its passage. A great many people say that in heating the air you take heat from the furnace. But in heating the air you utilize gas that would otherwise be wasted. We use grate bars, fifty per cent. of air space. We set our boilers 28 to 30 inches above the fire. We have never had any trouble on any electric lighting station in New England that we have ever started. The Brush Electric Lighting Company started there, I think, nearly five years ago. I think they are using the same class of fuel to-day as they used then.

Mr. Cleveland: Mr. Upton referred to the use of water power in running electric light plant in New England. They are using water power at Holyoke, and Mr. Winchester is connected with the company there. I should be very glad to hear his experience in regard to running plant at Holyoke by water.

Mr. Winchester: Mr. President and gentlemen: I did not expect to be called upon to say anything about water power; but since Mr. Upton has referred to it, I will make some remarks upon the subject. I understood him to say that the water power in Holyoke had all given out.

Mr. Upton: I beg the gentleman's pardon; I said that I un-

derstood that it had stopped—not as a steady thing—the last few years.

MR. WINCHESTER: That is true. There have been days now and then when we have not had it.

MR. UPTON: That, in my opinion, kills it for electric light purposes.

MR. WINCHESTER: We are using a thirty-inch wheel with a capacity of one hundred and twenty horse-power. The price we pay for water is $300 for the day, and $150 for night power, such as we use in running electric lights. The actual expense of running by water power I could not give you exactly, because in our case we rent the power from the water power company, and they have their wheels all set. As compared with steam, of course the people there in Holyoke do not think there is anything like water. The actual cost of water is about one dollar a day for working days, for day power—that is, after the plant is once up. So far as electric lights are concerned, I would say we are running 103 arc lamps, Schuyler system, and we have made them pay from the start. We let the city have fifty lights, and we get fifty cents a light until midnight, and after midnight until daylight we charge fifteen cents extra. So all we are getting for an all-night arc lamp is sixty-five cents. We use nothing but water power, and have made it pay so far. I think if any one will come up to Holyoke, we can convince him that water power is away ahead of steam-power where you can get it. Where you cannot get it, of course you cannot have it.

MR. POPE: Are any lights running at Springfield, using the power at Holyoke? I understand that there is such a plant on foot.

MR. WINCHESTER: No, sir, we furnish no power for Springfield lighting.

MR. RIDLON: At the Amoskeag Mill, at Manchester, they run about 170 arc lights by water power. The cost of those lights for running an hour, is $1.25 a thousand, equal to gas. For running at three hours it is about 70 cents per thousand, using their water power.

MR. UPTON: Of one thing I would like to speak. A station

has recently been erected close to where I live. They are running ninety arc lamps on the Thomson-Houston system, 10½ by 12 inches, sixty horse-power. They do it at less than three dollars a night, for two. There is another station we recently equipped at Norwich. I would like Mr. Jepson to state just what it costs to run per night in his own way.

MR. JEPSON (of Norwich, Conn.): At Norwich we have a Jarvis boiler. It costs us for lights about four mills for fuel. We are running fifty-five lights now, and our coal bill last month was $34. To July 1st, we had run 106 days, and our expenses were less than $13 a day for running the plant. We paid from the start a dividend of two per cent., July 1st; we had made $550 odd. Our expenses were heavy on the start, because we had a good many things to buy, and we had to experiment on fuel. But we burn now bituminous coal and pea coal. We pay $4 for the bituminous coal, and $2 for the pea coal. Our coal bill runs from $31 to $34 per month.

A MEMBER: Do you run any day-light lamps at all?

MR. JEPSON: No, sir; we start some lights at four o'clock, and average about six hours a day running.

MR. DE CAMP: The statement of the cost for coal in lighting is an interesting one to my company, and I understand that the statements that are made here, while they are in one sense practical, are very largely theoretical. I would like to know whether they are made up as the results of practical work. For instance, in our station we start at half-past six in the morning with about 250 lights, and then we put out 75 at about half-past seven; the balance of those lights run until ten o'clock, P. M. At, say, three o'clock in the afternoon we commence to put on additional lights, say another hundred at three, another hundred probably at four; *i. e.*, our full load at four. In other words, the whole of our power is utilized for those two hours only out of the twenty-four. Now, at twelve o'clock we shut off a number of lights. The balance of the lights run from twelve o'clock to daylight, or six o'clock in the morning. Therefore, we are running our plant for twenty-three hours.

Out of that twenty-three hours we have a complete and full load for only two hours. Of course, during those two hours we are running with the greatest economy. Now, it is a very nice calculation, and very hard to get at for our general information. This is our method of making up the cost: We take the actual number of lights per day, or per month, and the aggregate amount of coal that has been used for that time; divide the number of lights into the pounds of coal, and it gives the pounds of coal consumed per light during that time. I find that our average run of lights, taking, for instance, the month of October, would probably be about ten hours. Now, dividing that into the number of pounds of coal we burn, we have the number of pounds of coal we have consumed per hour. Now, if there is any other station that is running on the same principle, that is running twenty-three hours, and they can give me the amount of coal that is used there per lamp per hour, I should be very glad to know it. I am asking that for my own information, so that I may see whether we are running under economy or not.

MR. JEPSON: Our coal is weighed, every pound we use, and our carbon boy takes account of every hour that every light is running, and reports are made out of every carbon that is burned, so that we know every night how many hours a light is running, and how many carbons we use, and how many pounds of coal we consume. The Jarvis Engine Company has written to me once or twice for estimates of the amount of coal we are burning, and we have figured it in every way, and used every method we could to find out, in order to run cheaply and to make money. Our customers only open for two hours a week for three months in the summer, and they want everything they can get. If they hire a light they want to own it. If they do not burn a carbon they want to be credited for it, so that we have to keep track to see how many carbons they do not burn. That is the way we keep track of our coal. We could not make it vary over four or five mills. Our man shunts off the lights at different places.

MR. UPTON: In regard to testing, I know of only one way, and that is the actual cost of twenty-four hours' run. We have

been very careful in all the tests we have made, and we have had every single thing brought in; taking the amount of coal used in banking, taking the amount of wood that is used, weighing the water—not taking any meter tests or guessing at the amount, or anything of that sort—and when the power came to be taken on the engines they were indicated every half-hour. If there were four or five stations each one was indicated. I would say right here that I think very often engines are used with a great deal more power than the electric light people give them credit for doing. At some times it seems to me there is more resistance than at others. In regard to tests, as I said, I think the only way is to take the actual burning test. In testing in mills we have changed the test that was largely used: It always used to be in New England, pounds of water evaporated per horse power per hour. We have brought that down in our tests to the total amount of water evaporated for a dollar's worth of fuel. Then every single thing will come upon the same basis.

MR. RIDLON: I think I can answer Mr. De Camp's question. The Brush Electric Lighting Company, of Boston, is running a system very similar, in regard to the matter of waste, to that to which he refers. It is running nearly the whole twenty-four hours, and it is estimated that there is used ten pounds of coal per hour per light, which is on an average of running six hundred lights. That coal is buckwheat mixed with common, at an average of about $3 per ton. I would say this to the Convention: That the public, taking these figures, will get a very different idea of the cost of electric lighting from what it really is. We have taken one very small item. Our carbons cost more than our coal, as we all very well know. A great many things go to make up the electric lighting system, which add very much to the cost of producing light, outside of the matter of fuel. I think the people at large will think that we must be making fortunes.

MR. DE CAMP: Those figures correspond with ours almost exactly. We make a written binding contract to furnish light to parties, from three till ten or twelve o'clock, whatever may be their need. Yet, in midwinter, or on dark days, those lights are very frequently called on at two o'clock, and sometimes as

early as twelve. We comply with that demand as a matter of policy. If, for instance, on our commercial service, even though there may be a party on the circuit that may be without the lights, it would not be worth while to take out those lights. Therefore, when a day comes which we see is going to be dark for a couple of hours, we try to be prepared to give those parties light if they call for it. I have noticed in a case of that kind, that if instead of running a full load between the hours of say four and six, in which our consumption of coal would be represented by three pounds, we start up at twelve or one, adding two, three or four hours to the day with that full load. Now figure up the cost of coal per hour, and instead of getting three hours, you get one quarter of an hour just for that short time. It shows that the question of utilizing your power or having a desultory business of using a part of the day, and only the whole of it for a very short time, makes a very great difference for the cost of coal.

Mr. Ridlon: As you say, we want to get at this by the average cost of the month, and charge it up to the different departments.

Mr. Duncan: We run a station at Pittsburgh very much under the same conditions as the station Mr. De Camp describes at Philadelphia, and I can give him the data for two years. We run there right along every minute in the twenty-four hours. We do not shut down on Sunday. There are very few lamps there that are required to be run on Sunday, and we accommodate those people although running at a loss during the day. But we want all the business that we can get, and that leads to other business. There is not a time in the whole week, there is not a minute, but that we are in operation.

Of course, I have not the data with me; but the average is something less than what Mr. De Camp stated. We have to keep the steam up all the time, and until within the last two months we have used soft coal. I can give the data to you when I get home.

Mr. De Camp: There is another thing that might be said about that. I do not see why our business should be different from

that of any other. There is certain business that is more desirable for us to do than another class of business. But I have never yet found out with sufficient correctness which business pays us the best. For instance, whether our all-night business, our long-hour lights, or our short-hour lights pay us the best. People come to us and say—and it is a very reasonable request—I want a light for two or three hours. Now that of itself implies this: In Philadelphia, if a man wants light only two or three hours, it is from the hours of say four to seven. Now, if that is the case, it follows that if those are his lighting hours, for six months in the year he does not use the light at all. Therefore, he says to me practically, "What will you charge me for lights for three hours during the six winter months?" Now, I have had, as a matter of equity to our customers, to make a graduated scale of prices, in which I fix a price for a twelve months' contract, a price for eleven months' contract, a price for an eight months' contract, and a price for a six months' contract. My six months' price is apparently a high one. It is as high as it is possible to make it; that is, to make it higher would be to make it prohibitory. But even at that price, and under those conditions, I have declined to make any contracts for those short hours. It is a question with me whether that is a desirable business for me to do; whether that will afford us as large profit, as running longer contracts for longer hours in the day, at a less price.

MR. DUNCAN: We have had applications on that three-hour basis, and we refused absolutely to make a contract for less than six months. If a man wants a three-hour light for six months, he pays the same as an ordinary half-year light.

MR. DE CAMP: Those are questions that will have to be met eventually in this business.

MR. SPERRY: In Chicago we met with this same trouble, and it is always the fact that they want these small lights at the time our machinery is running the heaviest. We have been able to meet this to some extent by making contracts with a printing company there which starts its presses at twelve o'clock; so that we shut down for about five minutes, long enough to make the changes in the connections, and start up again. While this matter

of power is before us, I would like to say that I have watched with considerable interest the trial and experiment, to some extent, that has been made in Chicago with our cable system. There they have overhauled their furnaces, and for the last six months have been engaged in utilizing the refuse from their barns. I find that information about this is very hard to get. As near as I can get it, I find that the expense is reduced about 40 per cent. Of course, this power is not better adapted to running cables than to running electric lights or anything else, and there are barns in every State where this same refuse can be obtained. If it really makes any difference in the cost of power, it ought to be well considered. They started first by having grate bars a large distance from their boilers, and then they had to add a blast operated by an oscillating engine and a large blower, and now they mix a certain percentage with soft coal, which they get for $2.60 per ton. I should think the mixture would be about one to five in weight, one of coal to five of this refuse. It takes an additional fireman, because the material has to be shovelled in constantly. I understand, furthermore, that this same device is being arranged to be utilized in Minneapolis or St. Paul.

MR. WEEKS: I would like to repeat what has been said in regard to cost and to emphasize it. With respect to the cost of fuel, it is simply the cost of fuel per lamp, per hour. If the public should get the idea that it cost only three mills per lamp per hour to run an electric lamp, they would say that we are robbing them.

I think that Mr. Upton made a very good point in regard to the connecting of the dynamo with the engine direct, without the intervention of shafting. When I took charge of the plant that I am now managing, they had not only shafting but counter shafting, and, as I demonstrated, were losing over 25 per cent. of their power. We have removed the counter shafting, and have taken steps to remove the shafting, so that we will have our engines and dynamos connected directly, not by one shaft, but by means of one belt.

In regard to the cost of coal, and the steam part of the plant, I think that is a matter of great importance. It comes right

home to every one of us. That is where the solution must be made in regard to the commercial success of electric lighting. We must watch our coal pile. We must get competent firemen. We must have competent engineers, of course. We must have firemen who understand the apparatus that they handle, and the principles of making steam economically. They must know how to fire our boilers. We have a high setting of our boilers. Mr. Upton said that they set their boilers at 28 to 30 inches above the grates. We go beyond that. We set our boilers 36 inches above the grates. Our boilers are almost identical with those described by him, and I think that our results in regard to the cost of fuel per lamp, per hour, will justify the wisdom of the move. The data upon which I base this are similar to those mentioned by Mr. De Camp and Mr. Ridlon, while our run does not correspond with theirs. We do not run the whole twenty-four hours. Still, I think they could get some benefit from us in regard to this matter. We run from dusk until daylight—from candle lighting to the putting out of candles—and we find that the cost per lamp, per hour, is three mills, taking note of the time when all of these lamps are put out. We put them out ourselves, and we have a record on our log-book showing exactly the number of hours we have run; this we foot up at the end of the month, and we know the total number of hours that have been run during that month; we know the total amount of coal that has been used, since we weigh it. From these data it is very easy to get the conclusion of three mills per lamp per hour, which is one mill better than the figures given by Mr. Upton.

MR. UPTON: What is the cost of coal per ton?

MR. WEEKS: The coal we use is bituminous slack, and costs us five cents a bushel; about $1.50 a ton.

MR. UPTON: I would say we have no one who is using a coal as cheap as that, except at Harrisburg.

MR. DE CAMP: We started with 8 × 16 Porter-Allen engines running eight 40-light Brush machines. The engines were run at 285 or 290 revolutions; and there is no question about the desirability of running in that way. But, when we came to increase our plant, having a number of small engines in, and

having learned in the first year—as, of course, was known before —that we could not run eight small engines of forty lights each with the same economy with which we run one large engine of the same capacity, and thinking that the question of safety would more than compensate for the saving in running the large engines, we put in more small engines. However, at the end of the year, when we increased our power, we put in a pair of 24 × 48 Corliss engines to run our line shafting. We had to run two lines of shafting, of course. With those engines we are running sixteen machines, and we do all our heavy work with them. As yet, we have never met with any mishaps, and we have come to the conclusion that the possibility, under careful management, of a large engine breaking down or getting out of order, is so small that the question of safety by running direct does not compensate us. It is quite probable that in the course of another season, unless we see some greater compensation for the increased expense of running small engines and running directly, we shall put in large engines.

Mr. Upton: I would like to ask the gentleman if he has indicated the power on his direct-acting engines, and also what power it takes to run his line shafting?

Mr. De Camp: Upon 66 feet of 6-inch shafting we run 8 No. 8 machines. That shafting runs at 300 revolutions. The other shaft, driven from that, is 40 feet, part of which is 4½ inches, and part 3½ inches. Competent and experienced engineers object to that thing on account of the friction load, and, of course, we employ an engineer, as we would employ a lawyer or a physician. We take his advice, or prescription, unless we have extraordinary reasons for not doing so. We can contrive, if we have the business, to put on eight hundred lights. In order to determine the judgment and the figures of our own engineer, I have, on several occasions, had an outside man to come in and make figures for me, and while they never exactly agreed, they have not differed very widely.

Mr. Weeks: So long as you can do that you can run those engines with the shaft economically. There is no question about that at all. I have demonstrated it in our own station. I think

that will explain the economical results Mr. De Camp has got out of his large engine in Philadelphia.

Mr. De Camp: We have eight Porter-Allen engines there, which are probably equal to any other engines of their size and class. We run five machines on our day load, and the question arose which is the most economical, to run the large Corliss engine, with a maximum of 800-horse power, or the small engine. We made a practical test of it, and we found it was economy to run the large engine even on that small load. That led us farther, and we found it was quite as economical to run the large engine on a load of 150-horse power. The figures of the friction were 85-horse power. That included the running of the sixteen dynamos.

Mr. Upton: In a case where they claimed that too much coal was used, we found that on a 50-horse power engine, it took 35-horse power to run the shaft.

Mr. De Camp: The first time I ever heard of the friction of the shafting, I went at it as a matter in our own interest; and the conclusion I arrived at when it was reported to me was, of course, there was power lost other than in making lights; but I was told by the parties who were criticising that method of construction, that it would take half of our power. That killed the thing. But when it took only less than ten per cent., I thought those other things would compensate for that loss; and, indeed, I have never heard a statement until now, from anybody, of what the usual friction load of shafting is.

Mr. Ide: We have two 80-horse power engines, and we drive four machines with each engine, one belt right over the other. We have been operating three years in that way, and we get satisfactory results. We run a circuit from 9 o'clock, with from 50 to 75 lights on that circuit. Our other engines have four 20-light machines. We run on that circuit from 60 to 75 lights. I have recently been putting in some plants at Chicago, where they use the belt directly. We extended the shaft to the engine and put friction clutch-pulleys on it. I think that is a very good arrangement. At very important stations it is a good plan to use two engines, right and left, connecting them both to

one main shaft with friction clutches, so that either or both engines can be used. This gives the advantage of using larger engines, as any number of machines can be driven directly from the main shaft, and any machines can be stopped or started when desired. This method of providing double power makes it expensive, but it provides a sure method of driving the lights at all times, for if either engine gets out of repair, the second engine can be started and the other engine shut down, without interfering with or stopping the lights; and you can handle the machines about as well as though they were driven by separate engines.

THE PRESIDENT: I want to call the attention of the Association to the fact that there is a large number of subjects for consideration. This entire morning has been devoted to the consideration of power. There are other questions equally important to be considered, so that unless an objection is made, or some person has something important to say, I think it would be as well now to take up some other subject. It is past 12 o'clock, and two hours have been given to the subject of power.

Mr. De Camp, of Philadelphia, has given you, perhaps, the best practical comparative tests between small engines and large ones. As I stated at the Chicago Convention, the Philadelphia case has done more towards settling this question than any other in the country. It is a place where both systems have been used in the same works. It is a place where the electric lighting business began with the beginning of its history, almost. They have experienced all the difficulties that any other station in the country has experienced. They have applied the remedies which experience and skill and the result of experiments in other parts of the country have suggested.

I have been asked to give the experience of our company in Baltimore. It would only take up time. It would be, to a certain extent, a repetition of what Mr. De Camp has stated, without having had the opportunity of making the close comparison that he has had. We used some small engines, too, which were replaced with larger ones, but they were all of the same type. We used one line of shafting in the beginning, 80 feet long,

4 inches at one end and 3½ at the other. Upon that we ran originally three engines. We paid $16,000 for that line of shafting, equipped with Frisbie friction clutch-pulleys. The shafting was made by the best mechanics in this country—Poole & Hunt of Baltimore—recognized so by all machine-makers, and within eleven months it was out in the lot, and sold for three-quarters of a cent a pound. We substituted the loose pulleys of the old fashion, cut the shafting in sections, and gave each engine its own shaft and its own load. We have put in larger engines. When we again increase our power, instead of putting in two 350-horse power engines, we will put one 500 or 600-horse power engine. The result of our experience in Baltimore is against the use of independent engines for each machine. We are in favor of large engines as against small ones, where you have work for the large engine to do. I do not intend to take up the time of the Association. I only want to make these statements, which are repetitions of what I said at Chicago; and, unless there is something important to communicate in this direction, I suggest that we pass to some other subject.

MR. OFFICER: I would like to say just a word, more to attract the attention of others who are more familiar with the subject, than for any other purpose. We are using the Thomson-Houston system alone for arc lighting. We are using a Westinghouse engine, 11 x 11; 65-horse power is what is claimed. We have a 14½ foot boiler, 62 flues, about 3 inches each, and about 52 inches wide. We run at times, when required, three 25-lamp dynamos of the Thomson-Houston system; sometimes only two. I have been studying, since we have been running, the question of coal, and, of course, that means Iowa coal. I presume, that means something different from the coals that we have had discussed here this morning. I have never used any other than Iowa coal, but I get about the best that can be obtained in Iowa. I use a grate that is manufactured in the west. I cannot, just at this moment, recall the name. It is manufactured by a gentleman in Omaha, who is connected with the Union Pacific Railroad Company. It is what he calls a rocking-bar grate. For the purpose of using slack coal, I put

it in at the start, supposing that I would save thereby. I do not recollect the distance of the grate from the boiler; but I think it is not over 18 or 20 inches. With that I have tried lump coal, of the very best quality I could find, as well as the slack coal. I have used slack coal, steam coal, pea coal, and then nut coal, all from the same mine, as well as coal from other mines. I have found by experience, that although this rocking-bar grate is claimed to be good for utilizing the cheap coal, it is cheaper for me to use the third grade or pea coal. The slack coal, for instance, I use at the rate of 14 pounds per hour per lamp while burning. The slack coal I am offered at $1.25 per ton. I am offered the steam coal @ $1.50, and the pea coal @ $1.75 for a year's contract. I have figured upon that very closely. When I am running thirty-four ten o'clock lights and seven twelve o'clock lights—the ten and twelve are both running together—all arc lights—it requires nine pounds of pea coal per hour per lamp, which I call a horse power, or 2000-candle power lamps, as they are called. It requires 14 pounds of the slack coal, whereas it requires only 9 pounds of the pea coal. The pea coal costs me really $2.02 per ton delivered in the house. The other is $1.57, delivered in the house right at the furnace. The difference is 34 cents per ton in favor of the pea coal in preference to the slack coal; so, of course, I use the pea coal. As to the lump coal, although that costs $3.00 or $3.50 a ton, I do not think that it is at all better than the pea coal. I do not know where the difference is—whether it is in the kind of engine or the kind of furnace—but I am certain that I am burning a great deal more coal than these gentlemen have named.

As to applying the belt directly to the dynamo, we run sometimes three dynamos when we have a full demand, and sometimes two; most of the year only two. Now I find this difference: between ten and twelve o'clock there are two hours to run. At the time I made the experiments only seven lights were running. It cost then about 22 pounds per hour per lamp. I do not know that I can enlighten you any more on the subject.

Mr. Weeks: As I have had some experience with the practice of which Mr. Officer speaks, it may be that in a few words I

can give him some suggestions that will point out where he is in error. In the first place, while the Westinghouse engine has a great many strong points, it is well known and generally recognized that it takes more steam than any other engine in Christendom. In the second place, he says that his boilers are set 20 inches from his bars. I think if he will raise his boilers about a foot and a half, or very near that, that he will find that he will make a great saving in coal.

In regard to the rocking-grate bar, I have investigated that matter very carefully. Under two boilers exactly alike, identical in their connections and setting, I compared them with the old style of grate bars, and found with 20 per cent. less coal I got 5 per cent. more work with the rocking-grate bar. I made a careful test, measuring the water with meters and weighing the coal. Of course the meters are not absolutely reliable; but I used the Worthington meter, which is the best. So I think that Mr. Officer's trouble is primarily in his engine, and secondarily in his boiler.

Mr. Upton: We have set since 1876 nearly three thousand boilers. We have tested very carefully the question of height, and we have settled on a given height of from 28 to 30 inches. We have set them as high as 48 inches and down to 36, 20, and 18 inches. We have set boilers in the west 14 inches above their grates. While 36 inches is too high for our fuel, it may do for very soft bituminous coal. But I think the gentleman from Council Bluffs will help himself if he will raise his boilers up, as you suggest.

Mr. Mayo: My experience would suggest to the gentleman that he had better put his engine in the scrap heap and get a good one. It has been my experience that that is the only way to make it pay.

Mr. Holt: I would like to say a single word on Mr. Upton's report as to the reliability of the relative tests between different localities and different systems of light per lamp per hour. I think when we get into it a little, it is totally unreliable. I do not want to take up the attention of the Convention at this time on this subject, but I would simply urge managers of electric

lighting systems to have their superintendents and electricians look into that matter. When you come to go into incandescent lighting, as you all will sooner or later, you will find, there is an extraordinary amount of buncombe in that question of lamps per horse-power per hour. We have already exceeded the time and I won't engage your attention any further.

MR. KERR: I would say that I am not a member of this Association, but expect to be an associate member. There is one thing I wish to say regarding the station out west that has been mentioned. If this gentleman will talk with our Mr. Brown, he will learn quite a number of things regarding that station which will be of advantage to him, as Mr. Brown knows a great deal about it. He was there at one time and investigated the whole thing. The chief difficulty at the station he has spoken of, which arose after the plant was put in, was caused by an improper draft on the boiler, and the amount of coal burned per square foot of grate surface. You will understand in putting up plants, that one very important thing is to get the right amount of coal burnt; and the grate surface so arranged that you burn your coal, and do not distill it. Now if you take all the space for gases, especially if behind your bridge wall you have no space at all, you will simply distill your coal; and you can distill coal and send it up the chimney just as rapidly as you please. I call attention to the fact that in no less enlightened a portion of the country than New England, we found recently a very nice place operated by very intelligent men, and they were burning six pounds of coal to the square foot of grate surface per hour. It is simply ridiculous. If their attention is called to it, they understand it at once, but it never occurred to them that that was the matter. Now the question as to how much coal you are going to burn on your grate surface depends on the amount of grate and draft. It is the draft and grate surface that determines the amount. Now at this particular place mentioned the engine would not start the damper up strong enough, and the boiler would not furnish steam enough for the engine, yet there was a large amount of coal used. Afterwards the draft was modified considerably. I believe if you will investigate the matter, you will find that it is owing to the way in which the coal is burned on the grate.

The other point I wished to mention is this, that I do not believe it is in good taste for any one to make assertions in this or any other Association, deprecating any machine built by persons for this class of work, or any other class of work, without laying before the Association the absolute figures on record from absolute tests, made in good hands, to back up the statement. These remarks should not be made at random, because parties are liable to be caught up in a way that would not be pleasant. Therefore, no remarks should be made that they could not be properly substantiated. If parties have had difficulty with any machine, there is a way of making reports in such a manner as will appeal to the intelligence of all, and prove something. Therefore, if any one has anything to say against the Westinghouse engine, or the Armington-Sims engine, or any other engine at any time, let him bring the record of the tests here, not simply a statement to that effect; as statements are often misleading and cannot be explained in a breath, whereas tests can go on record and be of a nature which can be discussed and looked at.

Mr. Sperry: As representing the electrical part of this Convention, I heartily concur with the remarks of Mr. Kerr, and would say that we have several Westinghouse engines in operation, and their economy is fairly good.

On motion of Mr. Cleveland, the Convention then adjourned until two o'clock in the afternoon.

AFTERNOON SESSION.

The President: Gentlemen, the subject before you is that of "Tower Lighting," and it is one of great interest.

Mr. Leggett: In considering this subject, I am a little in the predicament that Mr. Bowen was in the matter of which he spoke this morning. I had very little time for preparation. I had gathered together what I could during my trip here, with the aid of a scrap-book which we have used in our Conventions at Detroit, and the paper which I will read will be more particularly based upon the use of the electric light towers at that place, probably the best example of the use of electric light towers that has ever been made.

Mr. Leggett then proceeded to read his paper, as follows:

The System of Electric Tower Lighting.

In considering the subject of public lighting by a system of electric light towers, I deem it expedient to first direct attention to the system of lighting previously in vogue throughout the world.

Gas was introduced as an illuminant and adopted for public lighting. It was of moderate illuminating capacity, and the conditions surrounding its use were necessarily adapted specially to its peculiar characteristics. To have located so small a light at an altitude of a hundred to two hundred feet would have been supremely ridiculous, as its beneficial effects would have been entirely lost. Its proper height above the ground was necessarily a matter of experiment, dependent upon the illuminating power of the particular light supplied, and restricted by the well-known law that the amount of light from a given source varies as the square of the distance from that source. These considerations very naturally gave rise to the familiar lamp posts 10 to 12 feet in height, and to their location upon the street corners, where this limited capacity of the ordinary gas burner, or equivalent naphtha lamp, might be best utilized.

We, and generations before us, have become familiar with the long rows of gas lights upon our streets. It is true that as we approach a gas lamp we cannot tell until within a few feet whether or not there is a man beneath leaning against the post, and as we pass from one lamp to another we are filled with dread lest some highwayman may step from the side of the walk, or the end of an alley, and command us to stand and deliver, or what is more common, that some sand-bagger, lurking in the pitchy darkness beyond the fence in an adjacent yard or vacant lot, may bring us to a sudden halt with his sand-bag or slungshot, and do his own delivering. Still, without stopping to think how poorly we were served with the former gas lights, we look for familiar things, and their absence is for a little while a cause for remark.

Recall the many times you have driven along a street regarded as well supplied with gas lamps, and have leaned to the side of your vehicle and strained your eyesight to discover whether you were about to collide with a party in advance, or dash into a vehicle standing at the roadside. Recall how the row of gas lights served

to so blind you as to render it impossible to discover an object ten feet in advance.

I have premised at some length in order to show the reason for and to combat a popular prejudice, *i. e.*, that electric lights should be located on posts beneath the foliage and at the street crossings. This is a mistake, which grows out of our familiarity with low street lights at these locations. We fail to consider that necessity, induced by the capacity of the light, compelled this arrangement and altitude of gas lamps, and that the new and powerful electric lights with greater capacity require radically different conditions. Why are not our streets and avenues lighted by gas lamps located fifty feet apart all over our towns and cities? Simply because the expense would be prohibitive. So with the powerful electric arc lights, we find in the proposition of locating post lamps at every street crossing the objection of expense, not only for the plant itself, but for the lights. Thus, in the city of Detroit, we will presume there are 2600 street intersections. To light properly would require at least a lamp at each intersection, and this, at the very low price of fifty cents each, would amount to the enormous sum of $1300 per night. Then, again, by locating the light on a 30-foot pole, it would almost always be practically obscured by the foliage.

If located beneath the foliage, even if at the centre of the crossing, it is so low as to have its illuminating effects modified and wasted. The discomfort of walking or driving with such powerful lights constantly before the eyes is itself a logical argument that they are improperly located, and that there should be associated with their use an intelligent arrangement and adjustment of conditions suited to their peculiar nature and properties.

Profiting from experience with both low lights and tower lights, it appears unquestionable that for the immediate future, tower lighting is by far the more practicable and efficient. The effect produced is more satisfactory; it accomplishes, in addition to lighting the streets, the thorough illumination of all alleys, yards, back yards, and streets, which are not ordinarily lighted, and which cannot be lighted from the intersections. On the whole it produces an artificial moonlight effect, everywhere lighting well

the roofs and sides of houses, and outlining them clearly against a luminous atmosphere.

The eyes are not dazzled as by low lights, driving by night is rendered easy and delightful, a vehicle can be plainly discovered a block or more away, pedestrians can see and be seen a long distance. No lurking foe can find a hiding place, yards and houses are bright and beautiful, alleys can be readily scanned from street to street.

Union City, Indiana, was doubtless the first to employ the lofty lighting, and established a crown of lights upon a mast rising from the tower of its City Hall. This was in 1880.

Akron, Ohio, followed with one mast of boiler iron 208 feet high with six lights, and a similar group three-quarters of a mile away, upon a mast rising from the tower of Buchtel College.

Cleveland, Ohio, followed quickly with three similar masts, and has recently erected another. Two of these are 208 feet each, and the others 250 feet each, supplied with lamps of 4000-candle power.

About this period John S. Adams, of Elgin, Illinois, devised and patented a skeleton iron tower for this purpose, and has since taken out some fifteen or twenty patents, embracing many improvements in such structures. The patents and the business connected therewith are now owned by the Detroit Iron Tower Company, of Detroit, Michigan, which has established quite an extensive business in this and foreign countries. Since the introduction of the skeleton iron towers they have superseded the former masts, being stronger, cheaper, more quickly erected, and better adapted to the business. About 200 of them have been sold and are now in use. No place in the world presents the matter of tower lighting in so prominent, complete, and systematic a form as Detroit.

It has been said that while tower lighting was suitable for small towns and the suburbs of cities, it was not adapted for lighting large cities throughout. Detroit is a city of about 160,000 to 180,000 inhabitants. It is level throughout; has a solid business section, embracing about one square mile, with a fair average of narrow and broad streets. Beyond this is a belt of one mile in breadth, densely shaded, and comprising the better residence section. Thence to the city limits the houses are

smaller, spaces more open, and with less shade. The city formerly employed 3782 gas and naphtha lamps, leaving large areas which were provided with neither gas nor naphtha, said areas unlighted aggregating probably two square miles of space built up and otherwise improved. Now it has not a single gas nor naphtha lamp within its corporate limits. In the spring of 1884 the Brush Electric Light Company sought a contract for lighting a limited area by tower lights; the two gas companies and the naphtha company made strenuous objections, and even threatened to abide by their bids only in case they secured the whole job. The Brush Company then pressed for the whole job, and secured permission to erect an exhibition tower. It was erected by the Detroit Iron Tower Company, 150 feet in height, and provided with six 2000 candle-power lamps. The lights were started, and captured the public applause and enthusiasm at once. The council awarded the contract for lighting the entire city to the Brush Company by the tower system for $95,000. It was estimated that 66 towers of 100 feet, and 6 of 150 feet, with 290 lights in all, would be sufficient, but the company finding more to be advisable, proceeded without further compensation to erect 90 towers in all, of which 3 were 175 feet high, and the remainder 150 feet. The lighted area embraced all the occupied space within the city limits. It located about 390 lights in all, and started the lights on the sixtieth day after the contract was awarded to it. The towers were of the pattern known as No. 3 tower, made and erected by the Detroit Iron Tower Company. Each tower stands on a single wrought-iron pillar 14 feet high at the base, while the body of the structure is triangular in cross-sections, and of the same dimensions from base to top. Steps are provided at one corner, and an interior elevator leads from a lower entering platform to a top landing platform for the attendant. The lamps are fixed at the top of the tower in easy reach of the attendant. The towers are made of the best lap-weld tubing and malleable iron fittings throughout, with well tested guy rods. Each tower is stayed by two independent sets of galvanized wire cables, each set guying the tower in four directions, the upper set attached at a point about 20 feet below the lights, and the other set attached at a point about 50 feet lower down.

These guys are connected to one set or to two independent sets of vertical guy posts, which stand 6 feet in and 9 feet out of the ground. It will be seen that the towers of the Detroit Iron Tower Company can be erected on any street corner, that they occupy no more space than an ordinary lamp post, and do not in any way obstruct the view. We regard them as far superior to the tapering form of tower: 1st, because the tapering tower of 150 feet would occupy about 30 feet of space at the base, and so is not adapted for city use; and 2d, because the tapering tower is designed to be self-supporting, and is consequently liable to be blown down by very high winds or cyclones, while the style employed at Detroit, being dependent upon guys, is secured against all sway, and made wind-proof. I believe a wind pressure of 12 pounds per square foot is higher than has even been recorded at Detroit, yet these cable guys would readily stand as high as twenty or thirty times such a pressure, when estimated upon the exposed surface throughout the whole length of the tower.

In the business section of Detroit we erected the towers 1000 to 1200 feet apart in triangular order. This was widened to 1500 feet a little further out, and then to 2000 feet apart in the best residence sections, and, finally, 2500 to 3000 feet apart in sections remote from the centre of the city. The towers are distributed over an area of about 10½ square miles, and afford a thorough and effective light everywhere; so that Detroit has been characterized in the public press, and by visitors from all sections, as the best lighted city in the world.

What this Convention doubtless wants, is reliable information as a guide to action by its own members, and as a basis for action by the public everywhere. My opinion might be regarded as biased to a certain extent. I have, therefore, in the limited time allowed for preparation, gathered together the comments of others.

First, As to the strength of this style of towers; and secondly, as to the satisfaction afforded by the system at Detroit.

At Evansville, Indiana, there are twelve towers of this same system. The following letter will explain itself, and, although other letters are all of similar import, this one will suffice:

EVANSVILLE, IND., September 1st, 1884.

DETROIT IRON TOWER COMPANY, DETROIT, MICH.

GENTLEMEN: Your telegram of 30th ult., asking if any of our towers had been destroyed by the storm, came to hand Saturday night too late to answer you. Sunday morning I telegraphed you: "Houses blown down; trees by the hundred taken out by the roots; not even a rod bent on any of the towers. They defy all elements combined."

This city, on last Friday, was visited by the most terrible storm. Storm is not the proper name, it was one of the worst cyclones that ever happened. It looked for a while as though the whole city would be destroyed. Brick houses, frame houses, and stables tumbled together. Tin roofs were blown about the street like so much paper. Bricks, joists, and rafters were flying in the air. The largest trees were taken out by the roots and scattered in every direction. In short, it looked as if everything would be ruined. Of course, after the storm was over I was very nervous about the safety of the towers. Should they have been blown down you could have not been blamed, because it is unreasonable to expect that they should resist such a hurricane. But to my great surprise and satisfaction, I found that not even a rod had been bent in any of the towers, and I here extend my congratulations to Mr. Adams, the inventor of the towers. We can guarantee them against all the elements combined. No power on earth can move them if they are put up right, except an earthquake, which would take the foundation from under them. It is with pleasure that I can say this to your Mr. Adams, but it is only the truth as regards their strength.

Respectfully yours,

J. EICHEL.

The following gleanings from the Press, show the prevailing opinion of others:

The Grand Rapids *Daily Times* of August 23, 1884, says:

". . . . The Grand Rapids Aldermen—those who went—have returned from their trip to Detroit. . . . . The Aldermen said that the lights loomed up and sent a glow over the city which

equalled the radiancy of a very full moon. Friends passing through the streets in hacks could be easily recognized, and at a late hour even policemen could be seen. A prominent member of the Council, and one who has heretofore leaned heavily toward the gaseous side of the light question, said that the visit was an eye-opener to him—from this time out he was an electric light man from Electriclightville. Upon the whole, the visitors were well satisfied with their reception and are about unanimous in the belief that a city can be lighted successfully by the tower system. . . . . It is apparent that not only a majority of the Councilmen, but of the citizens as well, favor the lighting of this city by electricity perched upon towers, and that all efforts to the contrary will be merely dilatory and filibustering in their nature."

The Grand Rapids *Eagle*, of August 26, 1884, says:

"The substance of Mr. Pierce's replies to numerous questions, was about as follows:

'The Aldermen went to Detroit to see for themselves whether the tower system of electric lights was a success or not. We did not want to go as guests of Detroit, or of the Brush company, or when we were expected, and preparations for showing us the lights under more than usually advantageous conditions could be made. So we just started very quietly and went to Detroit without calling attention to our trip, at home, even. I am convinced that in this we were wise; that we got a better idea of the lights in their everyday, or I might more accurately say, everynight condition. I went to Detroit determined to be absolutely fair in all my investigations, if possible, to ascertain for myself what are the facts about the lights; and yet with distinct traces of prejudice in my own mind against these lights. I thought that they were a failure in essential features, and that I would find out in what, and demonstrate the fact to others. So I studiously avoided, until after I had seen them for myself, all persons who might be supposed to know about them, and all questions about them. I didn't propose to have my views any more warped than they were already, *pro* or *con*.

'In the evening we went riding about the city, studying the practical results of the lights from personal scrutiny. We were

over two hours doing this, and gave attention to the business portions of the town, and the residence portions even to the suburbs. We found how much or how little light was obtained where the business blocks are very tall, where the residences were dense, where the shade trees are large and old, and their foliage most dense, where the dwellings are infrequent, and the lights further apart. We tried to get an idea of every possible condition. . . . .

'From what I had seen I fully expected to find very dark places under the dense shade, the more disagreeable because in some other localities it was so bright. I found plenty of places that before entering them looked dark, so much darker than where we were, but on entering them there was plenty of light, so that I could distinguish persons across the street, or sitting in front of their houses—even 100 feet away or more, in the darkest places. And the whole street, the yards and the dwellings and the alleys—the whole of the city was equally well or better lighted than these exceptional places. In fact, contrary to my expectations I found no "dark" places, for in the whole city there was as much light as when there was a clear, full moon. I am free to confess that I was greatly surprised and agreeably disappointed. . . . .

'The light, as a light, is an unqualified success in Detroit, and this, even though it is a well-known fact that not all of the power needed and to be used, is yet provided, and that on some of the towers but parts of the lamps were burning. . . . . One thing is no longer in doubt, the lights are superior to all others, thus far, and are bound to please any fair-minded person, if they continue as good as when we saw them.'"

A letter from an old physician, published in the Detroit *Post* of September 4, 1884, says:

". . . . For twenty-nine years I have been in the practice of medicine. I have travelled the streets of the city at all hours of night and in every section. I have done so on foot, on horseback, and in carriage, and am familiar with it in all its phases of midnight gloom.

I have always dreaded my night work, not so much from the fatigue incident to it, as from the fact that the streets were so

gloomy and unsafe, especially in the suburban districts. Since the introduction of the light, however, this has all been changed, and the streets of the city are so transformed and beautified that during this pleasant weather a midnight excursion is positively enjoyable. . . . . Indeed, in a long ride which I took the other night, between the hours of twelve and two o'clock, which included a circuit around the northern and western part of the city, I found few places in which it was not easy to discern the hands on the face of my watch. The same route, during the régime of the gas company, was a terror to me."

A correspondent of the Boston *Herald* writes of Detroit:

"The city is lighted by the electric tower system, each tower a graceful structure of iron, as open to the wind and light as a spider's web. Four or five Brush lamps at the summit of each lofty tower shine down at night from the outer darkness, looking like so many crowns of living light shining above the city. The view from the Campus Martius up the long vista of Woodward avenue at night, is very beautiful. The five pointed crowns of brilliant light, mile after mile along the avenue, far above the houses, and on a level with the weathercocks of the churches, give one the odd impression that Detroit has a celestial apparatus of its own. The Brush company, I was told, agreed to light the city for $95,000 a year by its tower system. At the outset the local papers denounced the system as a failure; ridicule was heaped on the innovators, but to-day the praise is as universal as was the denunciation."

A Port Huron paper of December 31, 1884, in referring to Detroit, says:

"This city by night has been for some months the amazement of travellers approaching by boat or cars. The steward of a lake steamer said to me the other day: 'Whatever hour of the night, whenever we approach Detroit, I always called up the passengers to look at the electric lights, and they all considered the view a glorious one.'

"Approaching on the railroad, the view is equally enchanting.

It seems like a glimpse within the walls of Paradise to see the multitude of dazzling lights flashing in the distance. Every night there is the same steady, soft play of apparent moonlight. You step out of doors and unconsciously you say, 'What a lovely night!' But the chances are that the night is only lovely here. You let your vision range beyond the tall towers, you fail to discover a single star, and you finally convince yourself that the night is cloudy and dark elsewhere; that only Detroit is cheered by this superb moonlight.

"How tranquilly and resplendently these gleaming lights keep their vigils above the sleeping city! They seem so calm and still in comparison to the flaring yellow gaslight that it now requires quite an effort of memory to recall. The winds may howl, but the lights shine on as serenely as ever.

"Electricity lights not only the streets, but the front yards, the back yards, the porches, and the tops of the houses. A burglar or a clothes-line thief might almost as well start out to ply his vocation in the day as well as the night. A policeman, even if only half awake, would spy a murderer half a mile away.

"An Alderman humorously remarked in the Council recently that in his neighborhood there was so much light that the chickens couldn't sleep.

"It is very reassuring to a timid and wakeful person to look out in the still watches of the night and see the electric coronets so calmly looking down from the summits of the lofty towers.

"The lights flash almost simultaneously forth at nightfall, instead of the lighting process beginning in one part of the city about the middle of the afternoon and ending in another part about 9 o'clock at night, as it usually happened in the now forever extinct period of gas. Now at the touch of one man's hand the lightning springs from tower to tower with an effect more wonderful than ever proceeded from the hand of an enchanter."

Mark Twain, in the Detroit *Post* of December 17, 1884, says:

"Your city is beautifully lighted by those electric towers. It is the handsomest appearing city at night that I have seen."

The Detroit *Commercial Advertiser* of May 24, 1885, after a year of lighting, in a long and favorable editorial, closed as follows:

"The Detroit *Commercial Advertiser* opposed the new method of lighting the city as forcibly as the *Press*, but now does not hesitate to announce its perfect satisfaction with the tower light system, and acquiesces in the statement that Detroit is now the best lighted city in the Union, if not in the world."

The Detroit *Free Press* of November 17, 1884, in an editorial said:

"Toronto is now lit by electricity. The lights are suspended from curved arrangements that project over the sidewalks, and leave the lights a little higher than the gas lamps used to be. The streets are not as well lit as the streets of Detroit. Newport, R. I., has electric lights on poles about the height of a telegraph pole. In some streets these poles are all on one side of the street, and the effect seems to be better than where they alternate. Still Newport is not lit as well as Detroit. In the park, where the old Newport Mill stands, there are numerous electric lights, but the Park is not nearly as well lit as Union Square or Madison Square in New York, where one tall tower in each Park scatters a moonlight effect on the ground below. If the electric light company would put a few lights where they would do the most good and make some arrangements to keep away fogs, Detroit would be the best city in the Union."

From the *Cleveland Leader* of January 12, 1885, I clipped the following:

"A Cleveland gentleman who has been spending a little time in Detroit, states that he considers that city to be without exception the best and most brilliantly illuminated city in the world. The Brush electric light and towers are used, and the eighty-two towers that are in operation do not leave a spot in the city that is not full lighted. At first the people were opposed to this system, but as soon as there was a sufficient number of towers erected to show

its effect, they became satisfied, and now prefer this system to any other method of artificial illumination known."

The Detroit *Press* of June 13, 1885, says:

"Mr. Goebel took the right view of the street lighting question last night when he said, 'I prefer electricity, but I want open competition so as to see how much more than gas it will cost. If it costs too much more I want gas. That is the attitude of the people of this city; they like electricity, but they do not want to be robbed by those who furnish it.'"

The Detroit *Free Press* of July 4, 1885, in an editorial uses this language:

"The electric light towers which show their heads at certain points in this city are very graceful structures. To a remarkable degree they combine strength with a certain lightness and airiness which make them the wonder of all beholders. To the home returning traveller who reaches the city by rail when the shades of night have fallen, the effect is gorgeous in the extreme. So is it to the citizen who rests his weary frame by a ten-cent ride on the inexpensive ferry. Then are the towers to be seen as a fiery whole, as an illuminated system blazing away at the behest of the unseen engineer and firemen who feed the flames. These are the glories of the electric light system as shown by a year's experience with the towers."

Even the poet chooses it as his theme. In the Detroit *Free Press* of October 23, 1884, appeared the following:

The man in the moon looked down from on high
Upon the Detroit electric lights;
These mortals below, said he with a sigh,
Are infringing upon my patent rights.
They are on to my secret I plainly see
And are making light of it. Ho, ho! said he.
Then the man in the moon fell down in a swoon
And when he revived he was not feeling fine;
Those mortals down there, said he, I declare,
Are doing their utmost the moon to outshine.
If they keep advancing who knows but soon,
They 'll be snapping their fingers at me in the moon.

Again, in the Detroit *Journal* of July 13, after the gas companies had made a very low bid.

Rising to altitude empyrean
Shedding an effulgence bright,
Wrestling with the power of darkness,
Leggett's electric light.

How can we do without thee?
How let thy beauties pass?
When any one-horse bailiwick
Can spread itself on gas.

Moonshiny, shimmering brightness,
No planet hung on high,
Gives to the world such dayness
When nightness drapes the sky.
Old Venus with her satellites
Shrinks shyly out of sight,
When thou art open for biz,
Aristocratic light!

'Twill please lovers true and bold,
Cheer the children gay;
Help the husband find his key,
With the perpetual day.
And thou, Oh, Gas! hang low thy head,
Before thy nobby peer,
Thy bid is all that now remains,
To prove thou once wert *dear*.

On July 13, 1885, the President of the Detroit Board of Aldermen, Dr. Kaiser, said to a reporter:

"While I have been away I have visited Boston, New York, Portland, Albany, Quebec, and Montreal. Detroit is much better lighted than any of them, and I am willing the city should pay $20,000 more for electricity than for gas."

Edwin F. Conely, ex-Chief of Police of Detroit, and one of its most prominent lawyers, said, in the *Journal* of June 22, 1885:

"My experience with the electric light while Superintendent of the Police Department, convinced me that it was one of the greatest aids to the men possible. Just after it went into opera-

ı, I made a personal inspection of the city to see how it was ıg to affect their work. I found that the streets were really er lighted than they ever were by gas, and that the alleys and s of houses were generally as well lighted as the streets and ıues. This alone was a decided aid to the patrolmen. Un- the gas system the alleys, with the exception of some ten feet heir mouths, were totally dark. Now it is more important the alleys be lighted, so far as police work is concerned, than that the street be illuminated. Burglars seek entrance into ses generally through alleys, but when the alleys are so well ted as now, it is no easier for a crook to work in an alley than n the streets. I believe," added Mr. Conely, "that Detroit -day the best lighted city in the Union. People have now wn accustomed to it, and do not realize how well it is lighted. them visit some of the cities that are still lighted with gas, they will see the superiority of electricity at once. Edmund ce, where I live, was one of the dark spots, but it is far better minated than when gas was used. There will be a general prolonged howl of sorrow if gas is ever used to illuminate roit, and the people who will suffer the most will be the olmen."

ubsequently a large proportion of the patrolmen of the city ed a petition requesting the continuance of the light, and fully orsing all the statements of Mr. Conely.

Vhen a statement was made by the Secretary of the gas com- y at Grand Rapids, Mich., that the tower system of electric ting was not giving satisfaction at Detroit, a petition was ily circulated at Detroit addressed to the City Council as ows:

After one year of public lighting by electricity we prefer it as, and hope there will be no change."

his petition was within a few days signed by nearly every ness house in the city of Detroit, with scarcely an exception, a thousand in number, and by about six thousand other ens in all parts of the city, representing probably not less nine-tenths of the whole taxable property within the city ts.

Many testimonials and petitions of like nature from those more likely to know, came spontaneously from every quarter.

One from the Treasurer and General Manager of the street railway system throughout the city, stated that they were well satisfied with the lighting and preferred it to gas.

Another, from the omnibus and coupe company, was to the effect that they were perfectly satisfied with the system of tower lighting, and considered it an improvement on the former system of lighting by gas.

No persons, however, are so competent to judge, and no endorsement comes with so much weight and inspires so much confidence, as that from the leading physicians of the city. They are a learned, observing, intelligent, and conservative set of men, whose constant contact with the whole community, in every section of the city, and at all times of night, make them specially competent to judge. The following endorsement will therefore meet with ready acceptance:

To all whom it may concern:

We, the undersigned, practicing physicians in Detroit, having frequent occasions to visit all parts of the city during the night-time, in all kinds of weather, have found the city well lighted by the tower system of electric light. We find the streets, yards, alleys, and public spaces lighted as if by moonlight, and have no hesitation in saying that Detroit is by far the best lighted city that we know of. It is incomparably better lighted than ever before by gas or naphtha, and we hope there may be no return to the former régime of lighting.

Henry C. Cleland, M.D.	F. W. Owen, M.D.
Amos F. Hoke, M.D.	F. X. Spranger, M.D.
Frank H. Farnum, M.D.	E. P. Gaylord, M.D.
Otto Lang, M.D.	James Harvey, M.D.
A. Walsh, M.D.	C. A. Devendorf, M.D.
Henry F. Lyster, M.D.	C. C. Miller, M.D.
J. K. Gailey, M.D.	H. W. Longyear, M.D
Phil. Porter, M.D.	Geo. P. Andrews, M.D
Chas. J. Lundy, M.D.	W. R. Chittick, M.D.

F. D. Summers, M.D.

Again when it was suggested as a possibility that gas or naphtha might be restored, the populace in the suburbs turned out and cut down the naphtha posts in all quarters.

After all, the best evidence of the entire success of the system at Detroit rests in the following facts.

The lighting estimate last year was $95,669, and for the present year was $103,800. The Brush Company's bid for the present year was $89,300. The gas and naphtha companies which in former years, on the basis of $1.25 per thousand feet for gas, had always bid so as to absorb the whole lighting estimate, made this year a joint bid of $40,000 for the entire job.—$89,300 for electricity against $40,000 for gas and naphtha, was an argument calculated to affect the strongest possible leverage against a re-adoption of the system of tower-lighting. But after a contest lasting four months, during which period the disparity in the bids was pictured in every conceivable phase, the contract was again awarded the electric light company, by a vote of 18 out of 24 in the lower house, and a vote of 10 out of 12 in the upper house of the City Council.

If the foregoing is insufficient to convince this Convention of the success and utility of the tower system, a personal visit to Detroit, and individual inspection there, cannot fail to clinch the matter upon the mind of any interested party.

There remains only to explain the general features of the system:

We advise invariably the employment of 2000-candle power lights in preference to stronger lights. *Firstly*, because they are less expensive to maintain, require less power and less dynamo capacity; *Secondly*, because the line may be tapped at any point for a private light; *Thirdly*, because the lamps are interchangeable with the private lights, and should anything happen to either, the dynamo of the public or that of the private lights, any other dynamo can be at once connected into service; and, *Fourthly*, because they are strong enough, and a stronger light at the same altitude does not produce a practically different effect either near at hand or at a distance.

Thus following the principle before enunciated, it will be seen

that theoretically, and the theory is demonstrated in practice, a series of lights aggregating:

8000	c.p.	distant	1000	feet =	gaslight	16 c.p.	distant	45′
11000	"	"	1000	" =	"	"	"	38′
8000	"	"	500	" =	"	"	"	22′
11000	"	"	500	" =	"	"	"	19′
8000	"	"	200	" =	"	"	"	9′
11000	"	"	200	" =	"	"	"	7½′
8000	"	"	1200	" =	"	"	"	54′
8000	"	"	1250	" =	"	"	"	56′
8000	"	"	1500	" =	"	"	"	67′
11000	"	"	1200	" =	"	"	"	45′
11000	"	"	1250	" =	"	"	"	47′
11000	"	"	1500	" =	"	"	"	57′

After considerable experience with the towers, and profiting by observation in many other places as well as at home, I am convinced that four 2000-candle power lamps on each tower is neither too much nor too little, that the proper height for all purposes is 150 to 175 feet. Experiments have clearly demonstrated that with the 2000-candle power lamps any height less than 150 feet fails to utilize the light to the best advantage, and confines it within less than its effective area. An altitude of 150 feet appears to enable the light to reach to its effective limit. While higher altitudes do not enable it to give an effective light, at a greater distance, it materially reduces its effect at all points between the tower and this exterior limit.

After erecting some sixty towers of 100 feet each, we discovered so great an advantage in the 150-feet towers that we proceeded at once to raise them all to that height.

To summarize, therefore, I recommend:

1. Towers not less than 150 feet, nor more than 175 in height.
2. Lamps of 2000-candle power.
3. Five or six lamps for a central tower, but not more than four for each of the others.
4. That in dense business sections towers should stand about

1000 feet apart, for the best residence sections 2000 feet apart, and for the remaining sections and suburbs 2500 to 3000 feet apart.

5. That they should be arranged as nearly as possible in triangular order, so as to spread the light from at least three towers over the most distant sections.

6. In towns of about 12,000 inhabitants or less, one central tower, and others arranged 2500 feet therefrom, will accomplish an effectual lighting, and in villages of less than 5000 inhabitants, one tower with six to eight lights will answer every purpose, and should be about 175 feet in height.

7. That the tower standing on a pillar on its base, of uniform dimensions from base to top of tower, and sustained by guy cables, is the best, the safest, and the least expensive to keep in repair, while it banishes at once the argument by opponents that a large space must be occupied at the base.

In matters relating to towers, their cost, etc., I recommend you to the Detroit Iron Tower Company. They are the pioneers in the work, with a score of good patents, without an opposing claim on the part of any party. Their prices are reasonable, and they can give good title and quiet possession.

In a matter of so much magnitude, where opposing gas interests are only too glad to secure a bone of contention, these considerations are very weighty, for, from a financial standpoint, if obliged to choose between the destructive effect of a cyclone or that of a suit for infringement, my advice is don't fail to embrace the cyclone.

MR. OFFICER: I would like to ask one question. I have recently heard the complaint made that in cities like Detroit the electric light does not light the names of the streets on the corners, and, therefore, strangers have difficulty in getting about the city.

MR. LEGGETT: I will explain that. It is pretty hard work to light the names of a corner when they take the names all down. They played a sharp trick on us last year. When we erected our towers, there was no difficulty whatever in read-

ing the names on the lampposts by the electric light, but the gas company started a move to take in all the street lamps, and in taking in all the street lamps, they took in all the street signs, and the result was the names were taken off the street corners, and it was a subject of great annoyance. In the past year, however, a number of plans for street signs were exhibited to the Board of Public Works. Those were all placed out of doors at points the most distant from the towers, and there has not been the slightest trouble in reading any of the signs. In the city of Albany I noticed they had the same difficulty. They have simply put up little boards with the street name on them, and there seems to be no trouble in reading them.

THE PRESIDENT: How many towers have you, and how many lights are there to the tower?

MR. LEGGETT: Our entire city, the area of which is ten and a half square miles, is lit by 382 lamps. Of those, 358 are on towers, and there are 23 pole lights. As to the 23 pole lights, there is no earthly necessity for them. There are but two of them within the business section of the city, and that section is illuminated by the towers in every quarter. Members of this Convention and others have said, that while towers would do for the suburbs, they would not do for the business section of the city. Now this city can be as well lighted by towers as that park in front. There are 23 pole lights. We had two or three located within that first square mile. The balance of them were, I think, without exception, located in the vicinity of grog shops and special localities, where from some particular favor on the part of the Aldermen they succeeded in getting a light. They were put there more for advertising purposes than for lighting the neighborhood. But lighting an area of that character with 358 lights, displacing those 4780 gas-lamps, and lighting more than two square miles which never had a naphtha-lamp or a gas-lamp in it, presents the facts to the gentlemen in such a shape that they can do their own figuring, and find whether there is profit in the matter of tower lighting. It was estimated by the City Council, that if they attempted to light the territory that is lighted by the electric light, by other means, they would

have to add one thousand gas lamps and five hundred more naphtha lamps.

A MEMBER: I would like to ask the gentleman, if he lights his lamps every night in the year?

MR. LEGGETT: We light our lamps every night, moonlight nights not excepted.

MR. WEEKS: How do you find it where the streets are very narrow and crooked and irregular, as in Boston?

MR. LEGGETT: I will take any area in the city of Boston, and guarantee to do the lighting effectually on every street and alley and space within the city.

MR. CURTIS: How many of those towers will one trimmer trim in a day?

MR. LEGGETT: I think fourteen. We have one circuit with, I think, fifteen towers, aggregating sixty lights, which is more than twenty miles in length.

A MEMBER: Have you ever made an estimate how many pole lights it would take to light Detroit?

MR. LEGGETT: Yes, sir. We have estimated that to light Detroit, putting one light at each crossing where the city is now built up, would require 2600 lights; there being 2600 such crossings. That, at 50 cents a night even, would amount to $1300 a night. Nothing short of that would satisfy the people of Detroit in the matter of lighting their streets. There we would have to have a light at every crossing. You would then have the disadvantage that that light would not shine through a wall, and it would be so totally obscured towards the middle of the blocks, that you would have no light in your back yards and in your alleys, which are now thoroughly lighted. You have this advantage over the moon, that the moon comes from one quarter. We throw the light in four quarters. Therefore, every space which is free from the shade has a good light on it. Our city is a very densely shaded city.

A MEMBER: Do you consider a hood or any form of reflector over a light to be of any special effect in increasing the illumination below?

MR. LEGGETT: I have had that under consideration a number

of times. We put it first in the form of a flat reflector above the lights. Afterwards, we used a large parabolic reflector, but we could see no difference. I have no doubt it had a good effect in protecting the lamps from the weather, and it may have had some beneficial effect in reflecting the light and throwing it down. From one point, there is a slight objection to it. Take ordinary damp, wet nights, when it is very desirable to have the light. The light, at that time, illuminates the atmosphere so thoroughly that everything is brilliant and beautiful; more so than on any other night. If you put the reflectors over the light, you cut off just so much illumination from the atmosphere. We also tried, for our own information, putting a special reflector right over each lamp, and down close to the light, so it would be at about the top of the globe. But we could not see that there was any appreciable difference. We found the trouble at the outset, that shadows were thrown right at the base of the towers That we overcame by putting globes there which had the lower quarters ground.

MR. OFFICER: Had you any trouble from the breakage of globes from hailstones?

MR. LEGGETT: No more there than anywhere else. I suppose, with all the companies, the breakage of globes is an item nearly as great as fuel. We have found a very neat remedy for that in our company. Our Mr. Fitzgerald, a very ingenious and competent man, has devised a triangular lantern, with a flat glass bottom, and, if anything breaks, you just slide out that flat piece of glass, and put another piece in. With that the breakage is very slight, probably not more than one-twentieth of what it is with the ordinary globe. I think, if any of you are making street lights, it would be of value to you to send on for a sample.

MR. BOWEN: For the information of the gentlemen present, I would like to say that I have just received a letter from the President of the village of Seneca Falls. They have had constructed there a light of 50,000-candle power. This is quite a lengthy letter, and it is not necessary for me to read it, but he states that, on the whole, it is not entirely satisfactory as a light

for their village. They put it up experimentally, but have decided to go back to kerosene.

A gentleman inquired about the use of the reflector. A little diagram was printed in the *Electric World* of July 11th, of a test made by the Franklin Institute of Philadelphia, demonstrating that you get the best result from an arc light, elevated at an angle of forty-five degrees.

MR. WEEKS: I desire to make an explanation of what I said during the recent session, in regard to the Westinghouse engine. It is this: I regard the Westinghouse engine as a very good engine in many respects, and the only point in which I criticised it, I think, according to what the gentleman who represents that company here says, is not fully settled yet. It may be regarded as a mooted question. I say this, because I do not want to injure the business prospects of any company, and I do not want to hurt any individual's feelings. It is rather out of consideration for that, than the business interests of the company, that I make this explanation.

MR. KERR: I would just say, in reference to the Westinghouse Company, that I am much obliged to the gentleman for his remarks on that matter, and, probably, in the course of a year, at some of these future meetings, we may have a very interesting discussion on that very point. Such discussions cannot always be raised in a minute, but, if any one wishes to bring it up in good shape, we shall be always ready to argue it in the very best spirit.

THE PRESIDENT: The explanation of the gentleman develops two things which are very creditable: One is, that the feeling of courtesy among men engaged in the electric light business sometimes overcomes their judgment; the next thing is, that it is a very good thing for gentlemen connected with the by-ways of electric lighting to be members of the Electric Light Association.

You will now listen to Dr. Moses on the Incandescent Light.

DR. MOSES: I have listened with very great attention to all that has been said to-day on the subject of arc lighting. I will speak to you on the subject of incandescent lighting

alone; but I will draw some of my deductions from the remarks made to-day. I have listened attentively, and I have come to this conclusion in regard to arc lighting, that you gentlemen have reached a point of perfection in arc lighting upon which, for some time to come, we will not expect very great improvement. You have developed in one or two sporadic cases of eccentricity that, perhaps, two and one-half to three and one-half pounds of coal per horse power is what you may expect to get in arc lighting; that you will consume about two inches of carbon per horse power per night per hour, and that you have simplified and perfected your mechanism. You have arranged your central station; you have eliminated many things that destroy your efficacy in the way of friction, and you have brought the matter down to that point where now you begin to look around for new worlds to conquer, and you begin to fight each other, which is the best proof, to my mind, that you have solved the problem of arc lighting, so far as it goes. Now, you have been able to struggle against your common enemy, gas, and now, when you have eliminated it from the streets of the cities of the United States, or are on the point of eliminating it from the streets, you think the time has come for you to eliminate each other.

Now incandescent lighting has reached that point of development where, in many places, it has been able to compete with gas and with arc lighting. If you examine the most remarkable installation of incandescent lighting in the world, the one bounded by Broadway, Wall Street, etc., in the city of New York, you will not find one arc light running from the central station which supplies that incandescent light. And, why? For the reason that it is a bagatelle; the amount of light that would be consumed in the streets, in that incandescent light district, is so small as to be unnoticeable. You may say it is a very large amount of money to expend in a small area, and, for that reason, they have taken a territory which in no way conflicts with the Arc Lighting Company, and, therefore, their fields are distinct and bounded almost by a stone wall. Now, why do I make that statement? It is because it is based upon statistical observation. The street lighting of the city of New York is about 5 per cent.

of the total lighting of the city, and simply because you gentlemen have lighted the streets so well as to force more light into them; but, in smaller towns, the percentage is not more than 3. So you see that, when you have conquered the whole field,—and, of course, you cannot encroach on the field of the incandescent lamp, which is a small area,—the fields being distinct—you will find that when you have the whole thing, it amounts to about 5 per cent. Who have the rest? Our common enemy, the gas companies. Those gentlemen lay themselves over the communities of the United States to the extent of 95 per cent. of the light consumed. I do not refer to any other lay-over, because we have all recognized that. Now, how are they to be resisted? I believe earnestly, that the gas companies do not care any more than the incandescent light companies for the occupation of the streets. It is an expense; there is the lighting, cleaning of the lamps, cleaning of burners, breakage, and many other things in connection with it, which make it, to them, a matter of so much moment that they are anxious to withdraw. If we examine the statistics of gas-lighting, we will find that, in almost all cases, they have thrown tubs to the whales in all the communities where they are. They have lighted the streets at little profit.

In one notable instance I have heard to-day, of Detroit, they were willing to light the streets at a loss. For what purpose? Not so much to prevent the arc light companies from lighting the streets as to prevent them from getting a foothold in the town. They are not anxious to have gas lighting. I have conferred frequently with gas lighting gentlemen, and they admit that. Now, how are the gas companies finally to be met by the arc light? It has all the elements of success. Time, of course, will intervene; the people will call for it. The petroleum lamp posts will be cut down, and the arc light will occupy the streets of America. Now, the gas companies must be met by the incandescent light companies. If electricity is to prevail as an illuminant, it can only be by means of incandescent lighting. Now then, as soon as the arc lights have reached a point of perfection we will consider why they cannot expand their domain. In the first place, arc lights have reached a point in their development where the

elements of light-giving are fixed, a certain amount of electro-motive force—almost a standard—some portions varying from one-eighth of an inch to one-half of an inch,—a standard of carbons,—perhaps of seven-sixteenths of an inch on an average—the length of line, the attendance, cost of carbon, breakage of lamps. You cannot get any more light out of an arc lamp than you are getting to-day. You are getting, as Mr. Bowen remarks, 50,000 candles. You may get a quasi 2000. Now, in comparing an arc light with an incandescent light, you will find an arc light will give a great deal more light for the fuel consumed under the boilers. How much more? I think you may safely say five times as much light as an incandescent light for the amount of fuel; but every one will admit, that through a second subdivision of the light in the incandescent light you will get advantages more than commensurate. As to the cost of supplying carbons, that is more than the cost of supplying the filament for the incandescent light, so that we can eliminate that. Laying aside the first investigation, we come to this fact, that you can get five times as much light per pound of coal consumed in the arc light as you can in the incandescent light. But I think you will all admit that you are not going to get any more out of your arc lights. They have reached their limit. The problem was simple and has been solved. Now where is the limit to this fledgling incandescent lamp?

The incandescent lamps that were used in the beginning of 1879, the experimental lamps of Sayre and others, were not economical at all. They used large conductors in vacuums, but the vacuums were not perfect. Finally, at one great step, the world saw, in 1879 and 1880, a sudden departure in the mechanism of incandescent lamps. The principles already existed. They were known since 1846, from the time of Starr, who took out patents on the incandescence of carbon in vacuo. His vacuum was very poor, and his carbon was a thick rod. At that date, 1879, incandescent lighting, after a very long gestation, was born. We have to-day an infant seven years old, that, I think, is going to strangle gas with one hand and petroleum with the other. That infant is a robust one. He is to-day competing with a very well developed

man. He is competing with arc lighting. He is also competing with gas light, and is he to stop his growth in his seventh year? I think that is asking too much of him, particularly when he has in New York and elsewhere, some very good foster mothers, who are supplying him with all the experimental food that he may need, and he is gradually developing, and will continue to develop. But as he is, he can hold his own in competition with gas and arc lighting to a certain extent—an extent that implies this great development. Now what is he going to be in the next seven years? Let us see where his limits of progress are. Let us dissect the lamp to begin with. We find that the incandescent lamp as it exists is a very small filament of some hydro-carbon substance. That filament is of exceedingly small dimensions, and has been brought down to narrow limits as far as the present mechanical appliances are concerned. One of the most approved is made of bamboo, which in prisms $\frac{4}{1000} \times \frac{13}{1000}$ of an inch, have reached a fine degree of attenuation, and it takes excellent instruments and much care and fine material to allow of the formation of such a carbon.

But the difference between that and an ordinary carbon is immense. The difference between that carbon and the present carbon was like a tree to a church steeple. We have to-day in the incandescent filament by no means reached the limit. I may cite a personal experience. From some weed that was collected by my little six-year-old toddler in the garden, I made carbons so fine that they were as attenuated as a spider's web. They were carbonized, put into shape and made into a lamp, and they are burning now. It was a mere filament of irregular size and, like all vegetable fibre, it tapered from the base to the extremity. You must employ mechanical means to shape your carbon. That necessitates the use of a material of parallel fibre, or one that is perfectly homogeneous. As an example of the parallel, you have bamboo. As an example of the homogeneous, so called, you have tamidine. These materials have reached a state of manufacture where it does not pay to make them thinner than they now are. Here comes some one who is building his carbons. You find Cruto in Italy making a

carbon much smaller than is now used, which is built up by deposition from gases, and he takes a material that is already an excellent conductor of electricity—platinum—and deposits his carbon on it, and then he builds up a perfectly solid and homogeneous material that produces a wonderful economy. It costs a great deal. That is nothing. The first lamps cost $150 apiece. The day will come, gentlemen, when you will see carbon filaments made just as easily as you see thread made by the Willimantic Company. It is simply necessary to time your deposits. Now when that can be done, and that is simply a matter of mechanical ingenuity, you will get instead of a present economy of nine 16-candle lamps, or ten 16-candle lamps to the horse power, 10, 20, 30, 40, 50. There is no limit to it. I will take a carbon to-day and bring it to a point of incandescence where it represents 100. That is simply a question of fineness of carbon; that is all. The life of the lamp has to come from other matters. That is the result of experience, and the integral character of the material that is employed. It is probable that in some period hence we will have sixteen candles to the lamp and twenty to the horse power. When that day comes the death sentence of gas lighting will have been passed. There is no doubt in the world of it. It is simply a question of burning coal under boilers; that is all. To-day the cost of the incandescent lamp is less than one mill per hour. You, gentlemen, speak of exceptional cases of arc lights being run at a cost of two mills. Give me the coal to burn under a boiler and one mill will be the only cost of the incandescent lamp. Give me plant and coal and a fixed capital, and the other is simply a matter of cost of the lamps, which is, at the present prices, one mill per hour. That is based on a life of a thousand hours for a lamp at one dollar.

There are other matters that we can consider to-day in this antagonism between gas and incandescent lighting, which are well worth while bringing before you. The gas companies in almost all towns are located in the suburbs. They cover much ground. They are obnoxious and noxious and bulky. They must go to places where land is cheap and accessible for the large

quantity of coal that they use, to places where their residual deposits may accumulate, and they naturally seek the suburbs. What do we see there? From the gasometers the supply pipes commence with their largest diameters. But these gasometers are located in the suburbs where there is no population. So we see the greatest outlay for the plant takes place at a point where there is actually no demand for it. Large conduits are all wasted. They are only tapped as they diminish in size towards the interior of cities. How different the case of a central station incandescent plant. It locates itself in the very centre of the most densely populated portion of the town. It radiates from that point where the most light is needed, its larger and gradually tapering conductors tapering out to the suburbs and less populated districts, entirely the reverse of the gas lighting process. Now you may locate your electric light plants in the very centre of the business districts. This mile square that we heard of at Detroit probably pays one-third of the gas bills. An electric light plant can be located in the centre of that and radiate in all directions, not for the purpose of street lighting—I beg to withdraw from it—but for the interior. There are other considerations in connection with incandescent lighting that render it preferable to gas lighting. Incandescent lighting means: air not heated, pure, no danger from fire; and altogether it is a far preferable light. I will not dilate on it. It is acknowledged by the whole world.

Let us look, gentlemen, at the probable future of electric lighting. As soon as it has been rendered possible to supply twenty lamps to the horse power, sixteen candle lamps, that instant incandescent light can be produced at a figure lower than the cost of production of gas and can be sold in preference to it. As we ought to speak well of the dead I am going to speak well of those who are going to be dead one of these days. The gas companies at a very little additional outlay, can convert all their gas—their illuminating gas—into a less carburetted gas, more hydrogenized, where there is more heating capacity and less light giving capacity, and the very same conductors will be employed to bring that heat to our doors. It is a problem that you have

all had suggested to your minds, but it is one as feasible as turning on a stop-cock. There is nothing to change about the streets or houses. All you have to do is to manufacture gas in a different way. The day that it is positively announced that twenty incandescent lamps at sixteen-candle power can be produced to the horse power, the same thing will be accomplished. Let us look at one or two facts connected with the attaining of that result. If you look at a gas flame you will find a large surface. You may roughly estimate it at nine or ten inches superficial. Double that—twenty inches—and the edges will not include those at all—twenty superficial inches of surface of gas to be heated up to at least 2000 degrees. All that heat is absolutely wasted—worse than wasted—it is employed in heating and vitiating our atmosphere. Now let us look at the incandescent lamp. You find there a surface that altogether is not more than a quarter of an inch. Let us bring that down to an eighth of an inch. Do not look at the difference that I stated, between twenty and ten lamps to the horse power, but look simply to the difference between a quarter of an inch and an eighth of an inch of surface. That makes all the difference. It is a mechanical problem, and one that has to be left to those who have invented and brought the incandescent light to the present degree of perfection. The subject is an endless one. You will excuse me if I retire and allow others to speak. (Applause.)

THE PRESIDENT: Doctor Moses, I would like to ask you a question in regard to the statement you made, that the coal consumed under a boiler was producing five times more light in the incandescent form.

DR. MOSES: In the arc light than in the incandescent; but it is the subdivision of the light that enables it to compete in certain localities.

THE PRESIDENT: I take it that the gentlemen present, who are engaged in the business of electric lighting, are fully aware of the fact which has been put in such pleasant language by Doctor Moses, that the arc light stops at the door of the dwelling house; it stops at the door of the hotel, except in its lobbies and large spaces. Every man engaged in the electric lighting busi-

ness looks forward to the time when incandescent lighting will have reached such a stage as to recoup him for the losses he sustained in the early part of his contests, and provide for future gains and for future glory. No man who knows anything of electric lighting will pretend that arc light is a fit thing to put in one's bedroom. I think that if at least some of the arc lights were put there, he would fancy that he had a first-class case of jimjams, when he heard the short arc hissing in a small-sized room. The arc light is a pure light, a powerful light, and fills the bill exactly so far as it has been applied for street lighting and for the illumination of large spaces, and I am going to add, in spite of Mr. Leggett, clear spaces, because my experience is, that when you want to light a street in which there are trees, you must get under the trees instead of over them. The subject of incandescent lighting has been put before you in such plain and pleasant shape that I take it every man in this room—because you are all thinking and intelligent men—will carry away a bee in his bonnet that will keep him thinking for some time to come. When I say "we" I mean the men who have their brains and money both in electric lighting, and who are eternally searching for something that will be of a greater commercial value than that which we now possess. We have been looking forward to the time when we will have these promises redeemed in the incandescent field. Our pilots who started out with us on this voyage seven years ago, have come near enough to the shore to let us have a glimpse of the promised land; but I have never found any one yet who has given the wanderer a foothold where he can see an opportunity to secure his ducats in return. He has never been able to pluck the fruit that grows in this beautiful garden. I believe so much of what Doctor Moses said is true. I believe that the near future is pregnant with great results in this field of electric lighting. We will wait for that, and we will let the gentlemen who have made experiments keep them up until we get along to the point where we make the money.

There is one thing that I want to call your attention to, which was passed by jocularly and perhaps forgotten by many of those who sit in this room, and yet it had a most peculiar significance.

The remark was, that the arc business has gone on until it has eliminated the other illuminants from the streets, and now they are going to eliminate each other. I want to say that the first step was taken by this Association to-day to prevent that from happening. A resolution was passed here to-day, which I will call a protective resolution. We will see what it will produce in the next six months. I have made it a rule never to laugh until I am out of the woods. But we will wait and see. There is room now, and will be for some time to come, for all the arc companies which to-day exist. When the time comes that the ranks are crowded and they are treading on each other's toes, then it will be a question of the survival of the fittest.

MR. CLEVELAND: We have had a pretty full discussion of the questions that have been before the Convention, and unless some member has some choice in regard to the matter, I move that we adjourn till to-morrow morning at 10 o'clock.

MR. LEGGETT: Before we adjourn I would like to hear from some person who has had experience in the use of arc lights and incandescent lights on the same circuit. We have used them very slightly in Detroit; but I understand that in some places they have used that system quite extensively, and I should like to hear of the methods they pursued.

THE PRESIDENT: A motion to adjourn is before the Association, and unless that motion is voted down no further remarks can be heard.

The motion to adjourn was put and lost.

THE PRESIDENT: Is there any gentleman who is prepared to say anything on this subject of running arc and incandescent lights on the same circuit?

MR. LEGGETT: We have done that in Detroit with success using a cut-out of our own construction, or a Thomas or a Brush cut-out. Our circuits through the city for tower lighting occasionally drop into a place and use an incandescent light. If others have employed it and have discovered what cut-out is the best to use for that purpose, I would be very glad to hear from them. I think probably Mr. Holt could give some information on that matter.

Mr. Holt: I can tell you a little about that matter. It is a matter which ought to be inquired into more by the gentlemen who belong to this Association, because it is an exceedingly important one. It is a system which is so exceedingly flexible and can be adapted to so many different conditions, that I am sure anybody that goes into it will fall in love with it right away. Something of that kind has been done by the United States Company, I believe. I think they have done more than any other company in that direction. I am more familiar with what has been done in Grand Rapids, Michigan, by the company called the Grand Rapids Electric Lighting and Power Company. They have been using that system, and have been using a cut-out of their own, or Mr. Thomas' make, for about two years. They report it highly successful both in a commercial and an electrical point of view. It is a system to which any kind of incandescent lamp can be adapted. I suppose you are all familiar with the way it is run. The lamps are run in groups. The arc light circuit, for instance, is cut in, combining groups of lamps. The system used by the Brush Company embraces seven lamps connected to their 2000-candle power circuit. Groups of lamps are put in, and in connection with each group is put in what is called a multiple series cut-out, so arranged that if one or more of the lights should go out, this cut-out operates either to short-circuit the group and extinguish the rest of the lamps, or in some cases to throw in a resistance equal to the number of lamps cut out, or in other cases (and this is the system used by the Brush Company) to throw in a resistance which is somewhat less than the working resistance of any other lamp. Consequently the remaining lamps are dimmed only. Of course that cut-out is better for a general circuit. The lights being simply dimmed, the consumer is not deprived of light entirely. He can still see what he has, and he can immediately tell which lamp has failed. That, briefly, is the system. You will readily see it can be adapted to almost any circumstances except those of house lighting. We do not recommend it for house lighting because there is a well founded prejudice against intro-

ducing high tension currents into houses or in any places where they happen to get in people's way. But for stores, offices, hotels, and all places where people prefer the incandescent light to the arc light, it is a system which is beautifully adapted. I do not think that I can give you any further information unless some gentleman wishes to question me on some point.

MR. RIDLON: In putting these incandescent lights on the arc light circuit—for instance, I have a Brush No. 8 machine running 60 to 65 lights, and I take up the amount of ground required to furnish say 30 of those arc lights—what effect will that have on the remainder of the lights that are left running on the machine?

MR. HOLT: It has a steadying effect, because it is found that any dynamo will run better on a dead resistance than on an arc resistance.

MR. RIDLON: Then I would like to ask another question. In running a circuit of an arc light system, has the question of distance any more effect on six or seven incandescent lights than on an arc light?

MR. HOLT: No, sir; not a bit. Of course you allow for a certain loss in the circuit.

THE PRESIDENT: Wherever an arc light would burn, would this group of lights burn?

MR. HOLT: Yes, sir.

MR. RIDLON: Another question that suggests itself is this. I find by experience, that in lighting a drygoods store, notwithstanding the gentleman's statements, they are obliged to use arc lights to match the colors of goods. Now, if I am running from the arc light to this series of incandescent lights, and then from that series of incandescent lights, can I connect an arc light again; that is, can I have them alternate?

MR. HOLT: Yes, sir; anywhere.

MR. LEGGETT: At Detroit we had that very thing. We run at a distance of four miles. There are towers along the route. [illegible] the line, and put in two groups. We put in eight to [illegible] oups, of sixteen altogether; light up a store, pass [illegible] wers. Coming down town on the same circuit

there is a jewelry store, where we branch off, putting in two large Stanley lamps in the place of one arc lamp. Passing out again we pass to our park lights. I thought of the matter when our President was speaking a while ago and said he thought we ought to get the lights under the trees. Of course, in a city as large as Detroit, you will occasionally find a spot where it is necessary to put a light on a pole, where the light is absolutely cut out. Now, at a point of that kind on Fort street—that is the only point of that kind that I know of in the city—we had suggested putting in three Stanley lamps in the place of one arc light, stretching those through a distance of a block and a half. The remedy is at hand in that kind of manipulation.

THE PRESIDENT: What do you call the Stanley lamp?

MR. LEGGETT: It is a lamp made in Pittsburgh.

THE PRESIDENT: What is the candle power?

MR. LEGGETT: They have them from 200 up to 500. I think the two, with which they replaced the one arc light, are 500-candle power each.

THE PRESIDENT: Mr. Holt, the resistance is so arranged in these lamps, is it not, that a group of seven furnish the same resistance as one arc light?

MR. HOLT: Not exactly. The lamps I speak of will take somewhat less power than an arc lamp, that is, somewhat less electrical energy; but it is simply a question of adapting the lamps. You can put in lamps that you can run fifteen or twenty in a group. There is no economy in lighting in that system, of course, but you get the distribution.

A MEMBER: I would like to ask Mr. Holt what lamp he uses.

MR. HOLT: The Swan. Each group on the particular system I described takes about three-fourths of the energy of one arc lamp; so that, to put it into figures, a sixty-light Brush machine would run about eighty of these groups of seven lamps each. There is another point which may interest the gentleman, and that is, that where this system has been tried—more particularly in Grand Rapids, I am more familiar with that—they get about

the same price for a group of incandescent lamps as they do for an arc lamp. Their investment is very much less. The breakage of the lamps is about balanced by the cost of arc light carbons, and the attendance is nothing on the incandescent system.

Mr. Leggett: At Grand Rapids they have the capacity of about eighty arc lights. They have adopted it to a greater extent there than I know of in any other place. They say they have no difficulty there in securing from parties agreements to buy the lamps and to pay for the breakage.

Mr. Weeks: It is the same in Kansas City; we have the same system there.

Mr. Leggett: We find it more profitable to put in the incandescent than to put in the arc light.

Mr. De Camp: We have one customer in a small store that has one arc light in it. He has many times more light than there is really any necessity for, and he has said repeatedly that as soon as we can substitute the incandescent for the arc light he will be glad to have it. We have just temporarily got the incandescent. He said he would like to have those lights. Now, I said it is probable that we could give them to him, but the next question is the cost. He figured up that he had about what was equal to two groups of those lights, fourteen or fifteen gas burners. Now, I said, what about the price? Would you be willing to pay twice as much as you do now for the convenience of having those lights? Well, he happened to be in there in the evening, and it was a large room, in which the illumination did not show off very well, and I put the lights out and lit the arc light that was there. The contrast between the amount of light that he would get, settled the question for him, and he said, No. Now I am rather under the impression that that will prevail to a very great extent. There are exceptions to it, I know. Another case we had, was where there are nine arc lights in a long, deep store, and the proprietor has just seven gas burners over the bookkeepers' desks, and when we put the arc lights in there, and put an additional one over them for the purpose of lighting the office, it did not answer. It gave too much light in one place and not

enough on the extreme ends, and the bookkeepers complained of the shadows, and it was removed. Now that man would be very glad to pay the price of that additional arc light for each one, but I am very much afraid that the thing will not be general until we can offer some inducements in the way of price.

MR. RIDLON: I would like to ask Mr. Holt one question. Now in that chandelier [pointing to the chandelier that hung from the ceiling] is a group of seven lights. I want to utilize the current from the electric light, and it comes into this room, but I do not want but three or four of those lights; I want the balance of the seven lights in the next room. Now, at what distance is it economical to carry the fine wire—that is, the wire furnishing the current for the incandescent—how far should that be carried?

MR. HOLT: If the distance from the mains of all your lamps is the same, it does not matter how far you carry the No. 18 wire which we use. But if you have three lamps close to the mains, and three 200 or 300 feet, and three still farther off, it will be dimmer than it is near the main. It depends on the size of the wire.

MR. RIDLON: That is, I should put a small wire close by, and a larger wire, or a better conductor, at a distance, so that I could even take a small house and put my one or two lights in this room and another light in the closet, etc., regulating the size of the wire according to the distance.

MR. HOLT: That is it. It is similar, of course, in practice to the multiple arc system; but you are dealing with such a small quantity of current comparatively, that you are not obliged to calculate so nicely as you would have to do if you were dealing with a quantity of current to supply five hundred incandescent lights. I know of one place in Jamestown, New York, where the gentleman running the electric light there has several of those cut-outs. He has one place where he puts three lamps in a barber's shop, and another over a desk in a drygoods store, and another five hundred feet away in another store over a desk.

MR. CLEVELAND: I would like to ask Dr. Moses what he

thinks upon this question, and especially with reference to any element of danger, if there is such an element?

Dr. Moses: In the whole subject of the combination of electric lights and arc lights on the arc light circuits, and the combination of arc lights and incandescent lights on incandescent circuits, the conditions are entirely distinct. In one case, that of the arc light circuit with incandescent lights attached, the advantage of arc lighting is that of a current passing through a wire independent of the distance. Laying aside the resistance of the wire for the time being, all the current passes in series, so that for each lamp, all the current in the whole system passes. If you intercalate in the series a series of incandescent lamps, the same thing holds. The incandescent lamps are compelled to carry the whole of the current. Therefore, if you have fifty arc lights on a circuit, and five incandescent lights intercalated, the intercalation takes place in a multiple arc arrangement, because of the fineness of the fibres. By grouping those together in a multiple arc, you diminish the resistance, consequently it becomes capacious enough—these combined bridges—to carry the whole amount of current. If you were to intercalate a single incandescent lamp, it would vanish into thin air instantly, because the bridge is not heavy enough to carry the motive force. If an accident should happen to one of the group of incandescent lamps, the result would be, that by breaking one-quarter of the bridge the remaining parts would have to carry the current. Take away the four, and three would have to carry it. The result would be that the sudden extinguishing of two would be the means of throwing the whole fifty arc lights into darkness, unless you had an automatic arrangement by which they could be switched on again. It may be made automatic, but there are difficulties in the way. They do not like to handle those shunts, as the gentleman from Detroit says. The other method is adding the arc lights to incandescent light circuits. That is a problem of much more difficulty apparently, and requires an entire departure from the usual method in
istruction of arc lights. So far as I recollect, all arc lights
ated by the differential principle, with some few
t requires a mechanical application for the regu-

lation of the current. A portion of the current is shunted around the main current for the purpose of actuating. A portion of this current acts in moving the mechanism which moves the carbons. Now that depends altogether on the amount of current that passes through the particular carbons at that time. Such is not the case when you apply arc lights in the multiple arc. The result would be in putting an arc light in, that the differentiation of the multiple arc circuit would not act very satisfactorily. Instead of using a shunt circuit for the purpose of actuating the carbons, it was necessary to use the current direct in some experiments which I made.

This is an exceedingly interesting discussion. I am very glad it has been introduced. It is a very important one as being the nuptial ring, as you may say, between the arc and incandescent light circuits. The current that comes in the multiple arc circuit has to act instantaneously. Any who have observed a multiple arc circuit, will notice the pulsations of even the very lacings on the belt. The trimmer of the machine is a party to it. The eye is quick enough to see, occasionally, the rumble of a vehicle if the foundations of the dynamo are not sufficiently solid. Therefore, it is necessary to entirely eliminate the differentiation in a lamp that is to be used on a multiple arc circuit. A simile strikes me, which I once used, which I think will apply to it. In boxing, two men, one of whom is more skilled than the other, will engage, and the more skilful man will strike the other before he is aware of it, and after he is struck he will ward it off. Now that is the action of a differentiating dynamo. After the damage is done, the differentiation comes in and works. Therefore all gentlemen who are engaged in the manufacture of dynamo machines must bear in mind that the regulator, of any kind whatsoever, to be perfect should be the function of the current itself. There are mechanisms that work very quickly and very nicely; I could point to several; but they do not work instantaneously, and consequently do not exactly answer the purpose. Now a lamp to run on an incandescent light circuit must work instantly, and the only way to accomplish that is to make the lamp itself the function of the current. That I think has been accomplished. It was done in answer to the

call of one of the companies here. I spent a year upon it. It was only invented in answer to the demand. If a current is used to make a magnet after it has been saturated, that magnet responds to the action of the current almost instantaneously. To a certain extent De Bray has used that in his galvanometer. But with a saturated magnet you will get the same effects, not mathematically regular, but sufficient for the purpose. If a current now produces a magnet, that magnet is, practically speaking, a part of the current. I do not now go to work and suggest to you to use that magnet as a mechanism, but I would have the magnet itself in its operation control the current. If the current increases, the magnet increases in its power, and if the body of the regulator becomes a magnet, then you get this action instantaneously, and, therefore, any fluctuation of the current produces fluctuation of the mechanism. So I may say, that you may allow me to speak of the magnet as being a part of the current. Now, then, if you use that magnet as the regulating medium, you can eliminate this flitting that is produced by the mechanism. That is noticed in the regulating devices, and only in that way can it be done. Of course, in the arc light circuit, you have all your lamps in the series, and you know just when they are going to be put off, and you regulate accordingly; but it is a regulation that you are not called upon all the time to supervise. But if you are taking your lights, you will find that this arrangement with the intercalated system would be inefficacious on account of the fluctuation of the current. If you are going to manufacture an incandescent light machine, the machine itself must have certain regulating devices based upon shunt regulation. Will you be so kind as to tell me whether that has met with any particular favor?

Mr. Holt: Yes, sir; it seems to work very nicely. People are very well satisfied with it. The thing that you think the public will take to is just the thing they won't have, and the thing you expect they will not take is just what they want.

Mr. Upton: Do you consider that incandescent lights running on arc light circuits are perfectly safe? We have had three fires in Boston, caused by running incandescent lights on arc light circuits.

Dr. Moses: Until you get your incandescent light perfect, so that there is no way of a girder giving out on that bridge, I would not advise it. It introduces the shunt action, and that, in a household where you are using a current varying from a thousand to twenty-five hundred volts, is too much to ask people to handle. It should be so arranged that when the incandescent lamp is perfect you have the whole matter shut off from the consumer, so that he is not able to touch a wire or come within glass thickness of it, something by which it is not possible for him to come into contact with it. Professor Thompson showed me a very nice arrangement in which he used incandescent lights in series in this way; but it is all open to the objections of the girder breaking. You see the whole current has to be conveyed through that body of multiple arc lamps and they must be perfect. If there were a hint to-day that one of the girders was known to be imperfect between here and Harlem, there would not be a person who would ride on an elevated train for a week. So when you are having twenty-five hundred volts used on a current you do not want to run any risk of a sudden breaking of a link there, because that is always accompanied by disruption and with it a general smashing of things.

Mr. Upton: Then, Professor, this thing is a plaything, something like the storage battery.

Dr. Moses: I will say, in answer to that, what Franklin once said when he was asked, "What is the use of this lightning business? It is a child." "Yes, it is a child," he remarked. "What use is a child?" "Yes," said he "but a child can become a man." I say if you get lamps that can be relied on, if you use thick bridges and keep your lamps down in incandescence and put enough in so if one or two break it will not affect the balance, you can do it.

Mr. Ridlon: In regard to those fires, I think they emanated more from the resistance box which was used at that time. Now since that time those same parties by changing their system seem to have changed their boxes which run the incandescent lights.

Mr. Holt: I would like to ask Dr. Moses if he considers

that system any more dangerous than the present arc lighting system.

Dr. Moses: No, as long as you keep it within the control of the company. If you turn your lights on and off just as you do with the arc light, they are just as safe.

Mr. Holt: A great many of the patrons of the arc light companies turn on their lamps and turn them off again, most of them by means of strings hitched on to a lever that controls the switch. That is what we do. If they want to change a lamp, or if a lamp breaks, they are not in connection with the current at all. Only by gross carelessness can they get in connection with it. Unless a man sticks his fingers in the socket and catches hold of the gas pipe, he cannot get into connection with it. But children might be caught. That is why we do not want to put them in houses. They would do the same thing if arc lights were put in houses. But I think that you will allow that the system is not more dangerous put up in that way, than the present arc light system.

Dr. Moses: Provided the bridges remain.

Mr. Holt: Or if one breaks, a reliable automatic device acts and shunts the whole current past the remaining lamp. I look forward to the time, as Dr. Moses does, when we shall use the incandescent light as the only perfect light; but that time has not yet come. Until that time, the parties using the arc light system cannot do better than investigate the multiple system.

Mr. Leggett: I was going to suggest, in answer to the remark of the gentleman, that there seems to be a misapprehension as to the nature of this cut-out. The cut-outs are entirely automatic. They are made, you might say, of an automatic cut-out. They are arranged so that if you turn out one or two lights they will cut out. Under other circumstances, if your bridge breaks, as you term it, the result is at once to cut out all the lights on that circuit and save the balance of the lamps. I took occasion to inquire of our superintendent, Mr. Fitzgerald, as to the safety of the groups of incandescent lights on the arc circuit. He said there was no danger whatever, and that they were just as safe

as arc lights. The only possible difficulty that might arise would be in the faulty adjustment of the cut-out.

MR. CLEVELAND: I will ask the courtesy of the Convention to suspend the discussion a moment. It has been deemed best by the officers of the Convention that we take a final adjournment to-morrow at 2 o'clock, in order to enable gentlemen remaining over here to get home by Sunday. I therefore move you, sir, that this Convention adjourn *sine die* to-morrow afternoon at 2 o'clock.

Agreed to.

MR. RIDLON: I move that we adjourn until to-morrow at 10 A. M.

The motion was seconded.

The motion to adjourn was then put and carried.

THIRD DAY'S PROCEEDINGS.

AUGUST 20TH, 1885.

The Convention was called to order at 10.30 A.M.

THE PRESIDENT: Before listening to Mr. Sperry's paper on The Best Form of Dynamo, we will dispose of some general business affecting the interests of the organization.

MR. CLEVELAND: I beg to offer the following resolution:

Resolved, That the National Electric Light Association hold its Annual Convention in Baltimore, in February, 1886.

The resolution was seconded.

THE PRESIDENT: Before the question is put, I want to say to the gentlemen present, that the Executive Committee is now taking steps to broaden the usefulness of this Association, by making provision at the next meeting for the associate members who are dealers in supplies, machinery and the apparatus necessary for the electric lighting business, to make some sort of an exhibition of their goods there, so that those engaged in the business of electric lighting may have actual practical comparisons of what different manufacturers of articles use in their business, as well as theoretical discussions on what they ought to have. Each dealer thinks they ought to have the article he manufactures. The theoretical man sets up an ideal, to which, perhaps, none of

the dealers entirely conform. If the proposition to hold the meeting in Baltimore prevails, I think it perhaps would be for the advantage of the Association, it being a railroad centre and near to the National Legislature, which will be in session at that time. I take it for granted that, particularly at that time of the year, and in this early stage of the new National Administration, every man will have business in Washington. Are there any remarks on the resolution?

I want simply to say that the rules give to the Executive Committee the power of naming the place for holding the annual meeting, but we deemed it better that the entire Convention should have a voice in the selection of a place.

MR. WADSWORTH: I notice an absence of many of the western men here this morning, and as a large number of the members of this Association are from the west, it might be well to hear from some of them prior to putting this thing to a vote. Baltimore is considerably to one side. Holding this Convention in New York, at this time, and the next one as far east as Baltimore, will have a tendency to prevent a great many men from attending who live a long distance west. I agree with the President that there are advantages in favor of Baltimore, at that particular season, that cannot be said of any other place, and particularly the oysters, and the genial hospitality of our President. But there are a great many men who would be here now if it were not for the long distance, and the length of time they have to be away from their business. I would suggest that the motion lie on the table for a couple of hours until some absentees from the west get in.

THE PRESIDENT: It is now an hour past the regular time of meeting. The intention is to dispose of all the business of the Convention before 2 o'clock. We have from the west here, representing the electric lighting interests, Mr. Bowen, Mr. Sperry, Mr. Weeks, and a number of other gentlemen who have appeared before the Executive Committee, all of whom have signified their preference for Baltimore. Baltimore is hardly at one side. It is almost in the way of travel from both sections of the country. You can hardly go anywhere without going through Baltimore.

The first Convention was held in Chicago. In fact, the Convention was really born in Chicago, of the labors of the electrical newspaper men. The next Convention is now held in New York. I assume that it would not be out of place to hold the next one in the middle, between the two, and Baltimore is as near the middle as you can get. Do you make that as a motion?

MR. WADSWORTH: No, merely as a suggestion.

The resolution to hold the next meeting at Baltimore was adopted.

MR. WADSWORTH: In connection with this I move you now that a Transportation Committee be appointed. The Baltimore and Ohio Road will take, perhaps, four-fifths of the members of the Convention from Chicago to Baltimore. I suggest that the Chair appoint a committee to endeavor to make arrangements for rates for visitors from the west and from other parts of the United States to the Convention. There is no question in my mind but that any of the lines running into Baltimore would be willing to grant commutation rates.

The motion was carried.

THE PRESIDENT: The Chair will appoint on the committee, Mr. Wadsworth, Chairman; Mr. Bowen; Mr. Ridlon; Mr. Weeks; and Mr. Cleveland.

MR. RIDLON: I wish to offer the following resolution:

Resolved, That the office of this Association shall be located in Baltimore, and be the repository of all matters pertaining to the subject of electric lighting and motive power and kindred subjects, and that correspondence be solicited with all persons at home and abroad, all of which shall be placed on file, subject to the use of the members of the Association.

The resolution was seconded by Mr. Wadsworth, and adopted.

MR. WADSWORTH: I move that a committee of three be appointed by the Chair for the purpose of selecting from some of the prominent electric people abroad, a list of names for honorary membership in this Association. I make this motion for this reason, that by doing this we will place this Association in direct correspondence with the people on the other side, and

it will have a tendency to bring more closely under their observation the importance and benefits of this Association.

The resolution was adopted.

THE PRESIDENT: The President will appoint on that committee, Mr. Ralph W. Pope, of the *American Electrician* and *Electrical Engineer;* Mr. W. J. Johnston, of the *Electrical World*; and Mr. George Worthington, of the *Electrical Review;* all of New York.

Before I again announce Mr. Sperry, is there any member present who desires to say anything?

MR. SPERRY: Mr. President and Gentlemen—I fear there have been so many announcements with regard to this review that you have been led to anticipate too much of it. This is by no means an exhaustive treatise; it merely brings out some practical results of practical experience.

A view of this subject allotted by our President is rather a delicate task for one belonging to the rank and file of a dynamo builder. The problem of dynamo construction is susceptible of a large number of solutions, each form being the *best*, if our claims as manufacturers are accredited. There is no distinctive feature, however, from which something cannot be learned.

The art has advanced so far from the experimental stage, that to-day we are enabled to judge of the merits or demerits of a new construction from a practical standpoint, aided only now and then by theoretical considerations. We have learned by costly experience, that not always is that dynamo which gives absolutely the highest electrical efficiency best for commercial results. We have found that the mechanical engineer cannot be ignored in the designing of electrical machinery; that the salient points in the best experience in construction of engines and analogous machinery should be closely studied and followed.

The best dynamo is that which, with good economy, operates continuously with the least expense; one that does not require the constant attention of an expert, by no means, however, underrating efficiency in an attendant; one which has no delicate parts liable to derangement; one in which all the parts are accessible for cleaning and proper attention. Large journals, heavy frame-

work, and substantial construction throughout, are not to be overlooked in dynamo machinery any more than in a locomotive.

A tendency which is becoming less prevalent has been toward developing the greatest possible current with a given size or weight of machine. The construction in this case is generally too delicate, and all parts are overworked to such a degree that they are constantly giving way. The effect of this upon the commercial operator and public generally has been disastrous, establishing the impression that all electrical appliances are inherently unreliable.

The later constructions are more durable, less delicate as to details, and generally more satisfactory; although it is true they may occupy a slightly increased floor space. The armature, being that part of the dynamo in which the current is primarily produced, it may be considered first in order. Its arrangement should be substantial, compact, and with as few irregularities as possible which would tend to fan the air; yet be thoroughly ventilated, which is the most natural means of keeping down the temperature of the conductor. The core should in every case be laminated to prevent the generation of currents in the masses of metal. The armature conductors should not be too large for the same reason; and the mounting of the coils or armature conductor should be such as to avoid abrasion of the insulation from expansion and contraction, or from centrifugal action in or upon the same. They should, moreover, be accessible in all cases for cleaning and repairs. These coils being the seat of the development of electro-motive force they should be so disposed that every portion, if possible, be subjected to the inductive influence of the field magnets.

I have taken special interest in this feature, and find that the average, in the forms of machines ordinarily cited as examples, is less than 50 per cent. for that portion of each convolution of the generating conductor which is productive of electro-motive force, the remainder not only being idle, but offering wasteful resistance to the currents set up in the useful portions. The immense importance of this point will be readily appreciated, and requires no further comment here.

Waste space on the armature should not occur, although unavoidable in some forms, such as the disc armatures. The mounting and relation of the armature should be such in regard to the field that not more than two magnetic reversals occur with each revolution.

The winding of the coils one upon the other is found to interfere materially in case of repairs, and is sometimes a fruitful source of short-circuiting, but cannot well be avoided in the cylindrical or Seimen's form of armature.

The divisions of the armature conductor into coils should be as numerous as is practicable, especially where the electro-motive force is high, as it facilitates the insulation of the various parts from each other, and lessens the sparking and consequent wear and tear of the collector or commutator. Another effect of increasing importance is a tendency to lessen the undulatory character of the current generated, rendering it more harmless to life, and at the same time reducing its inductive effect upon adjacent line wires which so annoy our neighbors (?), who, I regret to say, are not always charitably disposed. (The remarkable facility with which some of our worthy contemporaries either detect, or imagine, the effect of induction from electric light wires, is only comparable with the sensitiveness of the instruments which they handle.)

The commutator should be substantial; the insulation between the segments and at the ends should be ample and of a character not liable to shrink, char, or absorb oil and moisture; the segments should be deep to secure long service; the size should not be too small to secure proper electrical construction, nor so large that the friction of the collecting brushes shall be felt, nor the centrifugal tendency on the segments operate to loosen them from their place.

The field magnets should be given special attention. Their arrangement should be that which would at once strike the practical mind as being the most natural. An effort should be made to avoid sharp angles or corners in both the polar extensions and the yoke-piece at the rear.

The helices or coils should be of the most regular form, cylindrical being, perhaps, superior in point of economy.

The disposition of the quantity or masses of metal in various parts of the field magnet should be also looked to carefully.

In some forms of machines a small core and coil may be found arranged to maintain the magnetic potential of a comparatively immense mass at the pole-piece. This arrangement is obviously bad. That form of electro-magnet most often met with in telegraph construction is, perhaps, of all forms the best, and should be followed as closely as possible in designing fields for dynamo machinery. The arrangement of multiple coils parallel to each other for the magnetizing of a single pole-piece is adverse to high efficiency, as the adjacent parts of separate coils tend to mutually demagnetize each other. This effect should also be looked to with regard to the arrangement of other parts of the field magnets. Often the polar extension and yoke, or any of the means by which the magnetic circuit is completed, are badly arranged as regards one another.

The arrangement of the field, as shown in the Gramme continuous current and Weston machines, that is, where the magnetic potential is developed midway in the length of the continuous core or piece of metal, labors under one disadvantage, which may be noticed as follows: Considering only one-half of the entire field of the machine, which would consist now of two coils, a north and south pole and yoke, we have the ordinary electro-magnet; and the opposite facing the said first set, although integral therewith, would perform the office of a keeper, and tend to satisfy the potential at the poles. The current in the two coils on the opposite side of the poles must then do the double work of—first, overcoming this adverse tendency of the lines of force and magnetic potential; and secondly, of aiding in maintaining such potential at the poles. This result is, of course, mutual with regard to the two sets of magnets facing each other. The efficiency, however, of this form of field is brought up to standard from the fact that only one-half of the mass of the pole-piece depends upon each coil or helix for the maintenance of its magnetic potential.

The distance between the pole-piece and the surface of a revolving armature should not be too slight. Experience has determined that the increased efficiency is more than neutralized by the increased heating effect; the space is more valuable for keeping down the temperature of the conductor upon the armature, and lessening liability to damage resulting from a high rotative speed. Substantial bands should also be provided to guard against the latter.

It is of no little interest to note the changes marking the successive stages of development of any given machine, as showing the effect of experience upon the more theoretical considerations, and bearings may be taken upon these successive stages, which may guide the close observer in the selection of his apparatus, or the designer in the future development of any special form of dynamo machine.

A beautiful analogy may be traced between the distribution of the potential in the ordinary electrical circuit, and that in what may be known as the "magnetic circuit" of a dynamo. In the first, the arrangement of the potential at various points depends upon the resistance encountered by the electric current at these points, varying in degree with the amount of such resistance. This law holds true also in the magnetic potential at various points in the magnetic circuit of the machine. Here the points of greatest resistance occur at the space which is between the polar extension and the armature core; and the degree of magnetic potential required at this point to perform the necessary work will be determined by the distance between the magnetic surfaces at these points. For the highest economy in the field, therefore, this magnetic circuit should be closed, and no space whatever provided between said armature core and said polar extensions. This, of course, being impossible, the aim should be as near an approach as is practicable, for the reason that the cost of maintaining the magnetism of the field is the function of the degree of potential required at the pole-piece, and when this is low only a small amount of current is required to maintain the field. In this case a large iron core, with a comparatively small amount of wire upon it, will suffice to do the work.

An erroneous idea, now going out of practice, has been to leave magnetic projections on the surfaces of the armature, which tend to short-circuit and satisfy the magnetic potential of the field, without compelling the induction to take place directly through the armature coils. The importance of a magnetic circuit as nearly closed as possible was pointed out as early as 1878 by Lord Elphinstone, who, at that time forecast the peculiarity, which may now be seen as the result of practice and long experience in the art, viz., the distance separating the armature and field magnet, the masses of metal, the efficiency at the field, and general construction of the machine, are determined by the character of the current to be developed; the greater number of convolutions, and the greater thickness of insulation between all the parts of the armature coil and its supporting core in case of high tension current, require a greater space for the coils, diminishing the size of the armature core, and increasing its distance from the field. The magnetic potential of the latter being, therefore, greater, its mass is lessened in both the pole-piece and core, with a proportionately large amount of wire required in the helices, and corresponding increase of energy required to maintain the magnetic potential. This peculiarity and difference may be seen in the two classes of arc machines, belonging, respectively, to the so-called high-tension and low-tension systems, and is even more readily apparent in the leading machines belonging to the two respective fields of electric lighting. This points to the fact, that the internal efficiency of a machine varies with a certain function of the electro-motive force of the current generated, being less for a high-tension machine, and greater in a machine producing greater quality and lower electro-motive force.

In electric lighting, there are many other features of vital importance, aside from the mere electrical efficiency of the generator; for instance, the cost of construction of lines, the distance at which the various operated devices may be maintained with economy, the economy of transmitting the current on the exterior circuit or lines, and, possibly, there also exists a difference in the transformation of electricity into light energy, by the use of the voltaic arc, all, perhaps, in favor of the high-tension system;

while the cost of maintenance, liability to leakage, and attendant expenses, especially on underground systems, the danger to life and property, and the economy of construction, and facility in coupling, especially in the incandescent system, are decidedly in favor of the lower tension.

The preponderance of the advantages in either of these systems, must depend entirely upon the circumstances and upon the judgment of the investigator, no two plants being attended by exactly the same conditions.

The matters going to determine the best form of dynamo, as has been briefly pointed out, are so numerous, and the various forms of dynamos are best adapted each for its peculiar sphere, that a general formula, prescribing that form which is best in all cases, would be impossible. The art, however, has brought dynamo machinery, the construction of which, at first, was attended by so many difficulties of a high scientific nature, down to a sufficiently practical basis, so that good judgment, with regard to ordinary mechanisms of a higher order, is relevant to the more salient features, and may be depended upon largely in guiding those interested in investigating this class of apparatus.

Mr. Spang: I understood the gentleman to state that a dynamo would produce the best results, by subjecting every part of the armatures to the influence of the field magnets. I represent the Ball unipolar dynamo, and it may be well to give you a little history of this machine; one that has been ridiculed by the scientific world to a great extent, but which is now coming forward and being recognized as the dark horse in the electric field.

The President: I must call the gentleman to order. It is not in order for members to set forth the merits of their inventions. You will observe that, while Mr. Sperry is the inventor of a machine, he has made no reference to any apparatus. If the gentleman desires the floor for anything else that affects the interest of electric lighting, we will be pleased to hear from him.

Mr. Spang: I wanted simply to make that point. Mr. Charles E. Ball, of Philadelphia—by the way he should not be confounded with C. M. Ball, of Troy, New York—about five years ago, constructed a compound Gramme machine, with two

armatures, each under the inductive influence and two pole-pieces. That machine gave four lights with a certain amount of power. By an accident, one pole was left off on one occasion, and he found himself able to produce five lights by one pole, and he took off another pole on the other, producing with about the same power six arc lights against four, giving rise to the Ball unipolar inductive dynamo. I might state that, in order to determine the relative merits of dynamo machines, it might be well for each party who has a dynamo, to try to get it in practical operation on the New York Aqueduct. There they are obliged to run, on an average, sixteen and a half hours a day. I think, if anyone wants to determine the merits of his machine, that is the place to do it. There are now six machines there, and I think in a short time, they will all know their merits. I believe, there is a desire on the part of gentlemen connected with the electric lighting business, to get at the best dynamo, and I think, it would be a very good thing if this Association would address a communication to the different electric light manufacturers, suggesting that, at some future time, they produce and hand over to the Association to be tested, dynamos, in order to determine their relative merits. The machine, that I think ought to be made, would be something that would meet the wants of the public. The wants of the public require a 5 ampere, a 10 ampere, a 15 ampere, and a 50 ampere. There are so many parties in the field making assertions about what they have accomplished and what they will accomplish, that I think they ought to be put to the test, so that the electric lighting men may be able to distinguish between the real dynamo experts and the "shysters." I think they ought to be put on their mettle, and made to show what they really can do, and, if in order, I would like to offer a resolution, that the President of the Association be directed to address a communication to the different manufacturers, to produce at some future time, say, within a year or nine months, a suitable number of dynamos, a 5 ampere, a 10 ampere, a 15 ampere, and, say, a 50 or 60 ampere, capable of producing not less than 30 arc lights. The reason I make the suggestion as to 30 arc lights is, that almost anybody can build a 5 or 10 arc machine. The trade

is calling for a 30, and even up to an 100 arc light dynamo, and I think it would be well to put each of the dynamo inventors on his mettle, to show practically which is the best dynamo in the market.

There is another point, if in order. I would like to take a little exception to the statement made by Dr. Moses—

Mr. DeCamp: The gentleman took exception to the statement made by Mr. Sperry, and now he is taking an exception to a statement made by Dr. Moses. I wish to suggest, with regard to these exceptions, that the remarks of the gentleman should be confined to giving the opposite view of the case. I see around me a number of gentlemen who, I think, are bristling for just such an argument as is invited by the gentleman now on the floor. We are limited now to 2 o'clock, as I understand it, and, if too much time is taken up with these arguments, we will not get through with our regular business.

Mr. Spang: These arguments, I think, will do more for the advancement of the Association, than anything else. The members, I think, ought to be properly enlightened on these different subjects.

Mr. DeCamp: We cannot be enlightened by gentlemen taking exception to the remarks of other gentlemen, and not answering them in any other way than by putting forth the merits of their own system, which is really the drift of what the gentleman is saying.

The President: The point of order is well taken. The gentleman will confine himself to answering the arguments.

Mr. Spang: That is all I have to say at present.

Mr. Sprague: I quite agree with Mr. Sperry that all the parts of the armature should be under the inductive influence of the magnet. I will call attention to the Edison machine. [The speaker made a sketch on the blackboard.] Those armatures, [indicating] are wound on a modification of the Seimen armature. The larger machines are wound with a single lap. Of course, on a machine of that kind it is necessary that the field shall be of the most powerful character, because the resistance of the armature, on account of the few number of turns must be

just as intense as possible. And, as an example of how you can get at the field aside from mathematical determination, it is well to run such an armature in its field with no load whatsoever on it, taking the intensity of the current by an electrometer, and then calculating the number of feet per second that the wire has to move to develope at its terminals an electric force of one volt. I believe that Mr. Farmer was the first to suggest that method. Taking such a field as the Edison field, let that part of the field [indicating] be the active field, leading out to this part where the lines cross each other. Now I want to get that crossing; that is the number of feet per second which a wire has to move in order to develop one volt at its terminals. We take blocks in the commutator, the length of the field in inches, that is, of the active part of the field, taking that [indicating] as the length of the field, multiply that by the diameter, in inches, of the armature; that by the revolutions; and that by the number of laps of wire there; divide that by 2750 multiplied by volts, and it gives you the number of feet per second that the wire has to move to develop an electric force of one volt. In a private test, we got a field so intense that the wire moved at a velocity of 25, developing a force of one volt at its terminals.

Mr. Sperry: I am very glad to have been substantiated. There is one point, however, that might be of interest to us all. It seems to me, that in operating, to get our money back out of the machines, we must operate practically. I do not care so much for the high scientific points as for the salient mechanical points. Now the actual difference, with regard to the electromotive force developed per peripheral velocity, might be, seen in this way. Take, for instance, a galvanometer [the speaker made a sketch on the blackboard] then let us take also a Seimen armature. In the older forms of Edison machines the length is greater compared with the diameter. Now, for a practical operation, of course, a certain peripheral velocity must be obtained by the wire that develops the current, and the idea is to get as high peripheral velocity of the wire as is possible with as low an actual rotation as is possible; because, one difficulty experienced

by some builders in the Seimen armature is this, that when the armature is made large in its diameter, in comparison with its length, so that with a small actual rotation a large peripheral velocity is obtained in the useful part of the conductor, then the useless part of the wire, is very large as compared with the useful portion of the convolutions. Now, when the armature is cut down as to its diameter, so that this relation will be large—that is, of the useful as compared with the idle wire—then, to get that same peripheral velocity, we must rotate the machine at a very much higher velocity, and, of course, there is the trouble with the waste of energy at the journal so that the golden medium is to be found between the core of the diameter of the armature and the amount of efficient as compared with inefficient wire, which will also be a function of the rotative speed.

Of course, the matter that was brought up by our friend, representing Mr. Ball, is a matter that has been gone into by people who had better facilities, perhaps, than any others here, and they have been published from time to time, and reference can be made to them. Although, when I speak of the amount of conductor that is rendered efficient as compared with the amount that is idle, I had reference to this view of the machine; that is, to the transverse section rather than the amount that is covered by the field, taking the other view.

Mr. Spang: I referred to this work on the Croton Aqueduct. There are five companies represented there; the Ball and four others. They said they were obliged to run about fifteen hours and a half a day. Two dropped out, and the other two are very anxious to get out. If you want to have your theory knocked higher than a kite, take your machines there. They all assert that the bipolar conductor machine is the machine; but, you put it to the practical test, six days and six nights, as the unipolar machine has been tested, and it will knock it higher than a kite.

...eaker was called to order by several members.

...sident: The gentleman will please take his seat.

...g: Is my resolution in order?

The PRESIDENT: Your resolution is to appoint a committee of three to address a communication to the companies, asking them to make tests of their apparatus. The resolution is in order. The gentleman will please put it in writing.

Mr. SPANG then prepared and read the following resolution:

Resolved, That a committee of three be appointed, who shall send a communication to each company manufacturing dynamos, requesting them to submit, within one year's time, a 5, 10, 15 ampere machine, capable of producing not less than 30 arc lights, and an incandescent machine capable of producing not less than 200 incandescent lights, to be tested by this Association.

MR. SPANG: I suggest that the committee be appointed by the Association, or by Cornell University. I think Cornell is now recognized as the leading electrical authority in the country.

MR. DE CAMP: Do you think it is possible for such machines to be constructed and ready for examination at the meeting in February?

MR. SPANG: So far as our company is concerned, it can be done. A company ought to be able by that time to produce such a machine.

A MEMBER: Inasmuch as we cannot have time to build these machines before the next Convention, I move that the resolution be laid on the table, and action be taken on it at the next Convention.

MR. SPANG: I think that is rather a cowardly way of disposing of it.

The PRESIDENT: I don't think the manly way to dispose of a thing is to vote it down. I think the resolution is a good one, though I doubt if the companies will avail themselves of its provisions. But we have nothing to do with that. If they were to do so, that test would be of the utmost advantage to us.

On motion of Mr. De Camp the resolution was adopted.

THE PRESIDENT: The Association will have a recess now of fifteen minutes, reassembling at five minutes past 12, and I hope gentlemen will be here promptly at that time. The question of placing wires under ground will be taken up immediately after recess, and that is one of the most important issues before us to-day.

The Convention reassembled at 12.15 P.M.

THE PRESIDENT: The Convention will now take up the matter of underground electric light wires. Mr. Pope will open the subject. He will be followed by the Okanite Company, and by the Callender Company, provided they confine themselves to the subject and not to the company.

Mr. Ralph W. Pope then read the following paper, on "Placing Wires Underground."

There is no more important question before the electrical community of this city to-day than the underground line problem. Every branch of business requiring the use of pole lines must shortly be brought face to face with its actual solution. While there may be a difference of opinion as to the authority of the State to compel the abandonment and practical destruction of the overhead plants which actually exist, and which have been constructed in accordance with the requirements of the proper authority, there can be little doubt that the building of new ærial street lines in the future may, and probably will, be absolutely prohibited in the cities of New York and Brooklyn.

As an instance of the present state of affairs, I will call your attention to the dilemma in which the United States Illuminating Company finds itself to-day. This corporation shares the business of electric lighting for streets with the Brush Company in this city. Owing to the enlargement of the Grand Central Depot, at Forty-second street and the opening of Depew avenue, it was found necessary to abandon the Forty-fourth street station. A new station was equipped at the foot of Twenty-ninth street, East River, to which the lighting circuits were to be led when the machinery was in readiness. This change required the construction of a new fifteen-wire line through Twenty-ninth street—a distance of 3600 feet. Upon application to the Commission on Electric Subways, a permit for this purpose was refused. I was informed by President Lynch that they would soon be turned out of their old station, that their customers could not be supplied from their other stations, and that nothing re-

mained but for the commission to provide a method by which they could comply with the law.

I narrate this incident merely to point out to you the conditions existing here to-day. To show also that overhead construction is not entirely prohibited, I will read you the following item from the *Evening Telegram* of August 19th:

"*More Telegraph Poles.*—Gangs of workmen invaded West Twenty-eighth street this week, and erected telegraph poles along both sides of the street, against the protests of the residents, who claim that, according to the law recently passed, the telegraph companies have no right to erect any new poles, and must put the wires underground."

The members of this Association being chiefly interested in arc lighting outside of the territory embraced in the Daly underground bill, this subject is not in every case one of immediate importance. It is not at all improbable, however, that other and smaller cities may enforce similar legislation; therefore, it will be wise for you to consider the whole matter very carefully.

As you are, of course, aware, the burying of the existing wires in New York is a complicated engineering problem. Not only are there thousands of wires owned by various companies and individuals, but the different systems require different subterranean facilities. Curiously enough, the thunderbolts of the press have been hurled with the greatest force against the Western Union Telegraph Company for its apparent calmness in ignoring the requirements of the law. As a matter of fact, this company began placing wires underground ten years ago, and employed an engineer for the express purpose of preparing plans for a general system, which was to include at least the Western Union, Metropolitan Telephone, Gold and Stock, and American District Telegraph companies. I understand this work had to be abandoned mainly because of the destruction of the gutta-percha insulation by the effects of the steam-heating pipes. The system adopted was that used in England—the simple drawing of gutta-percha cables through ordinary cast-iron pipes. A similar plan was recently put in practice by the Commercial Cable, popularly known as the Mackay-Bennett Cable Company. In the upper

part of the city, however, the cable is simply buried in the earth, being protected by a line of bluestone flagging on the surface.

The Edison incandescent system, as you are doubtless aware, is entirely under ground, and is too well known to require attention at my hands. It was planned with a view to the requirements of the Edison Company, but is apparently not suitable for all branches of the electrical service, so far as has yet been demonstrated.

I am not aware that any arc-lamp wires have as yet been placed under ground in this city, neither have I learned of any plan by which they were to be so treated. I consider this the most difficult part of the work, and the most expensive, on account of the large wires required, and the necessarily high potential of the currents used. In reply to a question: Is this feasible? I say yes; it must be. It may be an expensive method, and more serious objections may arise in practice than are anticipated, but it is foolish to regard it as an impossibility in this day of great engineering achievements. Its success requires plenty of dollars and plenty of sense. Furthermore, if arc lighting is to increase in this city it must be done, as no franchises for further aerial construction will be granted. As this crisis was bound to come, I think it was well timed, for the reason that a reconstruction of the lines in this city would soon be necessary under any circumstances, and if lines must be abandoned, it is less wasteful to destroy those already depreciated in value, and which should have earned their cost, rather than those which are in good condition. The lines of the electric lighting companies in New York are not of a permanent character. The poles are slender, and the fibrous covering with which the wires are supposed to be insulated may be seen hanging in threads from the weather-beaten structures as you pass along the streets. I do not know how long it was expected that these lines would endure, but they are apparently not long-lived. The cost of placing them underground is an expense which I presume our lighting com-
nies are, at present, scarcely prepared to assume. It will
ly vary in different localities and under given conditions.
absence of any plans presented by the companies, the

New York Commissioners will devise means by which conduits or subways will be prepared with facilities for accommodating the wires of all companies. It is to be presumed that they will then notify all interested parties, that by lease or purchase, they may obtain perpetual rights in such subways to place their wires No system will be approved which is not sufficiently comprehensive to meet the demand for all classes of service.

This leads to the question as to what plan is the best, and this must be finally decided by the commissioners after examination of the various schemes presented; and their name is legion. I will not occupy your time by even calling your attention to the various theoretical devices presented, of which I understand there are over 250, as most of them can never be of any practical value, while but very few are in actual operation.

Of conduits which have been really used for this purpose, and have, therefore, been tested by experience, but two have been brought to my notice. These are the conduits which have been put down to some extent in Philadelphia and Chicago. The latter is known as the Dorsett Underground Conduit, and has been in use in Chicago for over a year. The same material has, however, been in use underground in the form of sewer-pipes for six or seven years without apparent disintegration. A conduit used in Philadelphia was troubled some time ago by explosions, which arose from the accumulation of gas in the manholes. This was supposed to have been caused by leakage from the gas mains. While in Philadelphia last year I saw a line of arc lamps which I believe were supplied from wires through this conduit. With a little more time at my disposal, I should have been glad to have looked into its details more thoroughly.

The conduit, as used in Chicago, appears worthy of attention as being the most successful system of this class which has thus far stood the test of experience, and may now be seen in actual operation occupied by telephone, telegraph, and electric light wires. It is made of concrete, formed by mixing asphaltum and silex, and is moulded and at the same time hammered into lengths of about three and one-half feet, through which are formed at the same time longitudinal ducts, the whole having the general ap-

pearance of a tubular boiler. One end is provided with a flange, so that the sections may be securely joined, when they are cemented with the same material applied while hot, and a perfectly tight joint formed. At the corners of the streets manholes are provided, formed by the same material. These, like the conduit itself, are gas, sewerage and water proof. The material is said to have stood a Government test of 5,500 pounds crushing strain, per cubic inch. It is also a practically perfect insulator, and the ducts are smooth and uniform inside, being about two inches in diameter. Mr. Callender informs me that he has drawn several miles of cable into them without any apparent damage from abrasion. This system was adopted over a year ago for the municipal wires in Chicago, and also by the Underground Conduit company, of which Professor Elisha Gray is President.

A recent experiment, which will, perhaps, be of interest to you, appears to have fully demonstrated the insulating properties of the concrete, which being cheap, may possibly be practically utilized in this novel manner. The test, which was but an experiment, consisted in placing naked wires in one of these underground conduits for carrying electric light currents. The plant of 40 lights is still running successfully. While this proves conclusively that such wires may be safely run in the manner indicated, it was not intended to continue the arrangement permanently. The installation of the wires spoken of, where they are liable to dampness or other interference at the terminals of the pipe, was very complete, and the installation rendered very thorough by the following process, which is given for the benefit of those interested: The wire, before being drawn in, was thoroughly taped from the union between the naked copper and the outside wire for a few inches at either conduit terminal into the pipe. A cork, slit to receive the wire, was then placed upon this latter and crowded into the end of the conduit about an inch. Then this countersunk space was filled with a compound which completely insulated the wire at the terminals of the tube, and made these air, water and gas tight at the same time. As some of the members present may have occasion to visit Chicago, I would suggest that it might be worth their while to satisfy themselves of the merits of this con-

duit as can be done most effectually by examination and inquiry on the spot.

Whatever conduit may be used, the individual insulation of wires is essential. The tests which have been made thus far with insulation for arc lamp wires, under these conditions, are exceedingly meagre. A series of tests are now being made by the Standard Underground Cable Company, of Pittsburgh, which will doubtless be of value in this respect.

It is a peculiar trait of humanity that we prefer to profit by our own experience, rather than abide by the testimony of others. I would, therefore, respectfully suggest that such members as can do so, should, after careful consideration of the subject, undertake the construction of short experimental underground lines with a view not only to preparation for the future, but to ascertain for the benefit of the entire fraternity the best insulating material for subterranean arc wires. In cases where antagonistic legislation is threatened, the very fact that you are laboring in that direction may prevent your being forced to do so, hastily and against your will.

The burying of the wires in New York is a work of great magnitude, and should properly have been begun many years ago, in order that we might have thoroughly learned our trade, instead of undertaking so vast a job as mere apprentices in underground work.. My brief intercourse with the Commissioners leads me to believe that they fully realize the importance of performing the duty which has been placed upon them, with a proper regard for the continuance of all classes of service without interruption. When the task is finally completed, and the wires work satisfactorily, with bills all paid, and dividends appearing regularly and frequently, we may be happier—I am sure we shall be older.

Mr. Benjamin: Mr. President, as we have a few moments to spare, it might possibly be interesting to the gentlemen to relate some experience which I have had with an under ground conduit, that is, an underground cable. About two years ago I went over in company with Dr. Seimen, of Lon-

don, and with his brother, Werner Seimen, to Leipsic, in connection with the matter of laying cables for the purpose of running the electric railways. Previous to that time the Seimen lights along the embankment of the Thames had been run on underground wires and a very little, if any, difficulty had been experienced. That led me to make a careful examination of all the cables and systems which were in use in Europe for the underground transmission of power and underground transmission of currents. I found practically three systems in use, the first, that which was best known, was the Berthoud-Borel. That consists in imbedding wires in cotton, wrapping them in cotton, and saturating the cotton with linseed oil which had been subjected to a very high temperature, and incorporating with it a certain amount of resin. It was found that linseed oil of that character would not melt at a low temperature and that its insulating powers were very high. It possessed the quality of not hardening under any conditions of temperature. That is, a temperature as low as two degrees centigrade would not harden it, and it could be subjected to one hundred and twelve degrees Fahrenheit, without injury. That cable was in use by the French companies, also by the electric light companies, and in the opera house, and in fact there is now existing in France over 300 miles of telephone and about 170 miles of electric light wire. Only one difficulty occurred, and that was in the opera house where a portion of the wire was laid on a nail in the wall. The current was carried out from the tube along this nail and a little fire resulted, which did not amount to anything. That cable has also been largely used in London and all through Switzerland and through Germany. In France it is carried through the sewers principally. The sewers are run at right angles through almost the entire city, and when it comes to a local point the outer surface of the cable is taken off and, one or two wires, depending on what the loop should be, are taken off for branch offices. The second system is the gutta-percha system, that is, rdinary wires wrapped with gutta-percha, or treated with percha and enclosed in a lead tube. The specific conductacity of that is somewhat higher, but it does not stand

the temperature as well as the insulator I first mentioned. Two degrees centigrade will crack it. It is very difficult to bend, but it will last when put in the ground. The third system which is in use has been put down in London, which comprises a conduit made of beton. For instance, beton containing a number of circular holes, made for the passage of wires, and a rubber conduit in contact with that used for detached connections, is carried right through the streets. When that was laid there were a great many experiments made on compositions of all kinds for burying wires. The trouble that was found was that the short circuit occurring in any of the wires generated a great deal of heat; and it is a surprising fact that any composition containing water in crystallization will give up that water in heating. It was found that the heat would set free the water of crystallization and that the substance between the separate wires would become porous and the wires would connect themselves through the moisture. It had to be abandoned for that reason. It would work for perhaps a year or a year and a half and then break down. In this country I do not believe there is going to be a great deal of trouble. I imagine it is a bugbear which frightens us more than it should. There is no more difficulty in conveying a wire underground than overhead. I have tested 150 to 175 miles at a time through the telephone, and I have found that the transmission of speech was fully as good, if not better, underground than overground, and the actual cost of keeping them in order was fully 150 [?] per cent. less. It costs about 30 per cent. more to lay an underground system than an overhead system; but once there it is there permanently. A great many objections are made to the lead covering, one is that it would be subjected to corrosive influence. I have seen lead laid by the Faraday Company, of London, that was thirty-six years under ground and not affected in the slightest degree. When it was laid it was covered with coal-tar. In fact, the experience over there has been that it is much better for telephonic purposes to use underground conductors containing 36 to 38 wires. Now to come down to the ques-

tion of actual cost. The cost of laying an underground system is 25 per cent. greater. The cost of maintaining it is fully 150 [?] per cent. less. To give you some idea of these cables, they have machines made at three or four factories in Berne Switzerland. The machines will turn out from 250 to 275 feet of 36-wire cable per minute. The insulation of these cables is practically as perfect as is necessary.

The question of putting a telephone and an electric light wire in the same conduit, is one that is probably going to trouble us more than any other. I found that in the main sewers of Paris, which are perhaps 16 feet in diameter, the electric light wires are carried on one side, and the telephone wires on the other. There was no inductive effect at a distance of 16 feet. Where they have been laid in these beton conduits through London, they found that the Blake receiver had to be altered. A multiple contact instrument was necessary to overcome the induction. A certain amount of retarding influence affects the telephone wires, and by using a multiple contact instrument they had no difficulty in overcoming that induction.

After having looked over the matter, I am satisfied that a system to be satisfactory must have first an underground conduit in which the wires are bare wires and in which every wire can be individually removed. Take a single cable where the wires are wrapped together; let a wire be destroyed, and, as shown by the recent tests made by Mr. Hamilton of the Western Union, the depreciation will be fully 30 per cent.

THE PRESIDENT: Allow me to interrupt you one moment. You say the wires should be bare wires. Do you mean without any insulation?

MR. BENJAMIN: I mean without any insulation whatever. He showed that the loss was about 30 per cent. on the conduits now made. That applied to the cables they used in crossing canals and rivers and going under bridges, and in situations of that kind. But the conduit must be a conduit where the wires are bare and where there is no possibility of moisture. Take a conduit made of beton or cement and place it underground at a temperature of 50, and your wires will, under almost any circumstances, get hot.

A condensation of moisture will take place within the tubes. These tubes must be sealed on the end so that the wires are held almost in vacuo; if not in vacuo, at least in a condition where the temperature is dry. The wires must be absolutely insulated from each other at their ends. In most of the systems where the wires come out at the ends a drop of moisture will collect them together. There is always moisture in the man-holes under the street. There is always condensation on iron, and unless some system is devised to keep those wires individually apart, the system amounts to nothing. That must be provided for. Then the system must take into consideration a cable to lead into houses. A lead-covered cable treated with some material which has a high electrical resistance and a low conductive capacity, and which will not burn when broken, is a desideratum. Most all the cables have been made of substances which if broken and the wire heated, would burn very fast. I think that those conditions being taken into consideration, it ought not to be a very great while before we have the underground transmission of electrical currents in a condition which would be perfectly satisfactory to all of us.

MR. POPE: I would like to inquire a little further about the question of naked wires in the conduits. While it appears to me that it might be desirable sometimes, for the sake of cheapness, to run them in that way, yet with the large number of wires that we have in this city, for instance, telephone wires and telegraph wires, it appears to me that the room required for the insulation of naked wires will be so considerable as to be objectionable; and I would like to inquire further of the gentleman if those were all naked wires which were run through the beton conduit.

MR. BENJAMIN: Yes, sir, it was found absolutely necessary to do it.

MR. DECAMP: How many were there?

MR. BENJAMIN: One hundred and twenty-eight wires.

MR. DECAMP: Occupying what space?

MR. BENJAMIN: About 34 inches, I think. It was found that if you take covered wires and insulate them with any kind

of material and carry them parallel to each other the induced currents will interfere. The effects of induction have never been satisfactorily understood. We do not know to-day the inductive effects of currents upon each other. We do not understand cross currents. Take a number of wires supplying different circuits of outgoing and ingoing lines and bunch them together, and you will find results that you cannot understand at all. For instance, if I take a Brush 15-light machine, double the wires in the conduit I will not get more than one-half the candle power of the lights. The retarding effect upon the main outgoing line will retard the ingoing line to this extent, that you do not get any return, and yet you have the electrical resistance. Take a conduit with five No. 15 wires, say of two miles in length; couple the ends of those wires together, put a small storage battery on to determine the resistance and you will find it to be a certain amount. Now put the current from the dynamo here and you will find an altogether different condition of affairs. The induction of one wire on the other utterly upsets it. After making those experiments it was found absolutely necessary to separate the wires at sufficient distances to get rid of what we call the field of the wire. Every wire has its field. There is a wire going in that direction [illustrating]. That is its field. Its field depends of course on the intensity of the current and the amount of current that is carried. We have a return wire coming here [indicating]. That has a field. But the field depends on what is used up here [indicating]. Now those two fields mingle and the retardation is just the amount of the mingling of those fields. For instance, I will call that a single wire containing, say, 500 volts and 15 amperes. For the sake of argument I will say it is a field of that kind; that is to say, an inductive effect is felt at that distance. Outside that distance we get no inductive effect that is appreciable. I put a wire out here which contains 50 volts and 15 amperes. I find that its field is like that [illustrating]. Those fields do not mingle. But I increase the electro-motive force of this wire until its field mingles with that field, until those two fields cross each other. Then the re-

tardation upon the current which has the least electro-motive force is just the amount of that mingling by absolute measurement, and for that reason we cannot put the wires all side by side like that. With electric light wires, telephone wires—with any of those multiple contact instruments—it does not matter. There is sufficient current transmitted to overcome the induction effects. But when you get electric light wires and attempt to bunch them in a conduit, you will never do it satisfactorily.

THE PRESIDENT: Suppose you take a conduit on one side of the street in which you place ten arc light conductors, say No. 4 gauge or its equivalent. You carry your outgoing currents through those wires. Now I have, say, ten different circuits. When you return with those you return on the other side of the street. The positive wire is on one side of the street and the negative wire is on the other. Then what?

MR. BENJAMIN: You get no disturbance, or very little.

MR. COOPER: You said a little while ago that it was very desirable that we should have such a cable as you mentioned, and also the fact that they have been using this underground system on the other side. Have they arrived at any satisfactory conclusion in that respect yet?

MR. BENJAMIN: No, sir. In my opinion, the Berthoud-Borel cable is the best, though I think if some substance—such as illuminant salts—were mixed with the metal so as to deprive it of its inflammable character, it would improve it. All bitumen cables are inflammable. In the Paris Opera House the cable went along a nail and sagged, and the current was carried right out of the conductor and down the wall, which was wet. There would have been no fire from that, but the cable was made of a combination of linseed oil and rosin or beeswax, mixed together, and of course it flamed up and they had a beautiful torch. If it had not been discovered in time it would have burned the building down. It is very much so with those rubber cables. They will all burn. There is one objection, that I have not stated to a great many of the cables, and that is where the cable is made of such material as is to be poured upon the

wires—it will melt in spots and the cable will sag at those points and break.

But to recur to the former question. The reason why this conduit is used is to get these wires out of their field. The European law is very peculiar in regard to laying wires. You know the city of London is divided up into parishes or school districts. What the school district of Westminster does the school district of St. Paul will not do. Westminster will give you one side of the street, and St. Paul will insist on your taking the other, and when you get down to St. Pancras, they require you to go in the middle.

MR. SPERRY: I understood the gentleman to say that the cost of maintenance of underground wires was less than that of overhead wires.

MR. BENJAMIN: The United Telephone Company of Paris does not keep any men for repair at all.

MR. SPERRY: As this is an electric light Convention I would like to say that for electric light wires I have to keep a number of men for that very thing.

MR. BENJAMIN: They have to use very few linemen.

THE PRESIDENT: Mr. Sperry, what relation does the expense of maintenance of underground lines bear to the repair and maintenance of overhead lines, if you run both systems?

MR. SPERRY: I was talking with the Superintendent of the United States Station here last evening, and I asked him what it cost him per mile to maintain his wires, and the data I obtained from him were very interesting, though he did not give me the exact figures. He told me how many lamps he had, and how many miles, and left me to figure the result. Now we are operating about two miles of underground conduit from our central station in Chicago. We are compelled to go underground all over. We cannot cross even an alley overhead, and I would say that my experience is that the underground system is a very expensive one to maintain. We have tried every cable that money can buy. We commenced with a lead-covered cable which had to be abandoned entirely. We bought about two miles of lead-covered cable. Then we tried the various other kinds, which at

first seemed to be better. I might say, however, that iron conduits are used in crossing streets. I have some bare lines running a circuit of 42 lamps, for the Chicago *Tribune*, through this conduit system. Those were put in as an experiment, and can be used as pole wires. They are laid in contiguous holes, that is to say, this conduit is made of various sizes, usually 12 inches in diameter with seven or ten 2¼-inch holes in it. It is made of insulating material, most of which is silicates, and held together by asphaltum. I do not know exactly the amount of each, but the insulating qualities seem to be very high. The City Inspector gave our men instructions, and arranged the terminals as was stated in the paper here. After we enter the block we have to take our wires under the area-ways, and I may say that the cost of insulation and maintenance of these underground lines, especially where they go under area-ways, is very great. People occupying area-ways are constantly putting boxes against them, or throwing something against them. On the whole, I do not think that it is a very satisfactory system, although it is in its infancy, and things may improve.

MR. DECAMP: I think this question of the cost of maintenance of underground wires is a very important one, and I think that all the statements which have been made, from the fact of our limited experience, should be received very gradually. For myself I speak with great hesitation about the cost of maintenance of our overhead wires, which have been up now for nearly five years. The cost of maintenance of those wires is so low that I am under the impression I have not included all that belongs to that particular cost in my estimate. I happen to have in my pocket a memorandum of the last seven months' cost of our overhead wires outside of the buildings. There are about 67 miles. That cost, as I have it here, is figured on the basis of the cost of our fuel and carbons and all other expenses, under subdivided heads—the average of the cost for the last seven months has been .17 of a cent per lamp.

THE PRESIDENT: How many lamps on the line?

MR. DECAMP: About 800.

THE PRESIDENT: How many wires to the pole?

MR. DECAMP: We have on our Chestnut street line 14 wires. We have on city poles, on Market street, 18 wires, upon which there are also probably 60 telegraph and telephone wires.

THE PRESIDENT: How long is that line on Market street?

MR. DE CAMP: It runs from Thirteenth street down to Fifth. That is, about a mile.

THE PRESIDENT: And what is the cost?

MR. DECAMP: That line includes also about 60 telegraph and telephone wires, but the Chestnut street line, on which there are 14 wires, is, in round numbers, two miles. We have two men employed whose specific duty it is to look after our outside wires, to inspect them and see that they are clear, but we do not include their wages in this estimate.

THE PRESIDENT: How many lamps are there on those lines?

MR. DECAMP: Eight hundred. The specific duty of those two men is to run over those two lines and see that they are clear and hunt up grounds, and were that the only work that they had to do, we certainly would not have use for those two men. We would not have use for one man. Those men are useful in doing inside work, putting up inside lamps, making changes, and such other work as may turn up for them to do. So that if you include the wages of those two men in this, taking it through the whole year, it would not amount to a very large figure. It would still be below what the impression is would be the legitimate cost of maintenance of overhead wires. Now, if you get an underground service that can be maintained at less cost than that, as Mr. Benjamin says, 150 [?] per cent. less, you have very cheap service.

MR. BENJAMIN: I would like to ask the gentleman if the wires in Philadelphia are not on iron poles. It seems to me the Philadelphia plant is a very good one. It is much better than the majority throughout the country.

MR. DECAMP: The Chestnut street line is on iron poles, and that is an objection rather than a benefit. Now I want to say further: Mr. Pope mentioned the condition of the lines here in New York as needing to be renewed in a very short time, and

that being the case, it would be better to spend some money to get them underground. When we first commenced operations, the question of overhead wires was discussed, but no one could give us any information that was valuable for copper wires. We could only come to a conclusion from the experience of the telephone and telegraph wires. It was a question of how long the insulation would last. Now about 40 miles of our wire have been up nearly five years. Within the last three months I have had reports from the superintendent, who has gone over our lines with a view to seeing their condition and the probabilities of their lasting, and we find nothing that gives any indication of the necessity for renewal excepting one case. In this I noticed myself, in passing along the street, where we had about half a block of wire which was in the same condition as I understand Mr. Pope says many of the wires in New York are, that there was a fraying of the insulation; but on inquiry, I found that it was a little section put in there at some time for some temporary purpose. I think that if we go into the question of putting down underground wires, and come to the conclusion that it can be done at an increased cost of 25 or 30 per cent. or 50 per cent., if we do not consider the cost of maintenance of those wires, we are going to make a very serious mistake. Mr. Pope makes reference to the scheme in use in Chicago, in which they use bare wires, and the method of plugging up the ends of the sections making them tight. I want to ask a question which will govern my opinion on that. What is the length of those sections?

MR. POPE: The length of the blocks. I do not know the length of the blocks. Mr. Sperry, I presume, can tell that. As I understand it, they are plugged at each man-hole and run the entire block.

MR. DECAMP: That gives you a stretch of how many feet of wire?

THE PRESIDENT: About three hundred feet.

MR. DECAMP: Is it possible that the wire can be brought through that viaduct at such a tension unless you have a very large space?

Mr. Pope: It lies there.

Mr. DeCamp: Then your material is supposed to be of high insulating quality, and there you get your insulation instead of on the wire.

Mr. Sperry: It seems to me there is quite a misconception. That conduit is not used for bare wire by any means.

Mr. Pope: I said that it was purely experimental. It is of interest as an experiment. Mr. Benjamin said that it is actually necessary—that I was not aware of.

Mr. DeCamp: Mr. Benjamin, I understand that they are proposing to use this plan in the city of London?

Mr. Benjamin: It is there now.

Mr. DeCamp: You made a remark which, I think, was very pertinent, as to the difficulty of preventing condensation. Now it just strikes me that this is the milk in the cocoanut. Is it not wise to drop this question of methods of doing a thing until we find out how to dispense with the milk? It does seem to me that making all these plans for getting our wires underground is equivalent to building a railroad before we have a locomotive. And another question I would like to ask, how often are these conduits that you speak of tested for grounds?

Mr. Benjamin: They are tested on the same principle and in the same way that the ocean cables are tested. Any difference of resistance shows that there is a ground. It is a regularly organized system, one of Sir William Thompson's.

Mr. DeCamp: Do they find as much freedom from the grounds on those underground wires as they do on the overhead wires?

Mr. Benjamin: Much greater.

Mr. DeCamp: That is very much in its favor. How long has that been in Paris?

Mr. Benjamin: Five or six years.

Mr. DeCamp: Are they generally utilized for telephone purposes?

Mr. Benjamin: For telephone and electric light purposes.

Mr. DeCamp: I am not asking these questions in a critical way, but there are some things that have got me very much mixed up. At the time gentlemen were making some statements as to the methods of operating their wires, I read in the *London Engineer* that the question of telegraph companies putting their wires underground in the city of London was before a committee, of the House of Commons, and it was specifically stated there before that committee, and the committee accepted it as true, so far as I understand, that the Metropolitan Telephone Company, I believe they call it, have 5000 miles of wire in operation in the city of London, and only half of that is underground. Am I correct in that?

Mr. Benjamin: You are correct, sir.

Mr. DeCamp: Then whence come these reports that all the wires of the telephone companies are underground?

Mr. Benjamin: You misunderstood me in regard to London. I think the objection raised in London to putting the wires underground is about the same as here. The Gowers have taken in all the money. The Bell Company has taken in most of the money here, and I do not think any of the local companies have made much. The chief objection to legislative action has been that very fact. That they can go underground is evidenced in Vienna, Leipsic, Berlin, and Paris, and that the resistance of the line is less is shown by reading the reports in any of the papers such as *Nature, Engineering*.

Mr. Cooper: How many lines of electric light wire have they got underground in London?

Mr. Benjamin: I cannot tell you the exact number. The longest circuit, I think, is on the Thames embankment. That is the Jablochkoff.

Mr. Cooper: And have they discontinued a great many of those lights?

Mr. Benjamin: Yes. I do not think there is going to be the trouble with underground wires that you gentlemen think. It is going to be a question of easy solution. Everybody goes on the question of insulation. It is not a question of insulation as much as it is a question of induction. If you put a wire in

there, it does not make any difference whether you put in two feet of insulation or one-sixteenth of an inch. You must get rid of the induction. A great many people, in making conduits, will put a wire in there and put another wire over it. Now it does not make any difference whether there is a foot or onesixteenth of an inch of insulating material between those wires.

MR. CURTIS: I would like to ask Mr. Benjamin if, in his investigation, he has ever found any underground system that he would be willing to adopt and put his money into?

MR. BENJAMIN: I would answer that by saying that I do not think I would put any money into the electric light business. If I was in the position of the United States Electric Light Company, and could not supply some six hundred subscribers, I would undoubtedly put down a lead-covered cable.

A MEMBER: With the arc light system?

MR. BENJAMIN: Yes; with the arc light system, and put it under-ground.

The PRESIDENT: The statement made by Mr. DeCamp will send us all to Philadelphia to learn how to run overhead wires.

MR. COOPER: I would like to ask what effect the induction of electric light wires has on telephone wires?

MR. DECAMP: Except out of respect for our fellow-workers for the public good, the induction part of it troubles us very little.

MR. COOPER: How do you get over it?

MR. DECAMP: I will simply say this, that the first intimation of trouble I had was from the Bell Telephone, when Mr. Morton was their general manager. We ran our lines down Market Street with return circuits. We had a few lights along there. The next line we ran down Chestnut Street and up Market Street. Then we were having a single side of Market Street, and one of the Bell Telephone customers complained to them of being unable to use his telephone on account of something which the Bell Company pronounced to be induction. There certainly was a great deal of trouble on that line. Mr. Low, our superintendent, said to me that it was possibly due to the fact that only

one side of the circuit was there, and he thought it would be overcome when the line was doubled. I told him to do it as soon as possible. It was done in a short time, and we have never heard anything more of it since. I would suggest that this Association appoint a committee to formulate a proper plan for running overhead wires. The reason why we are in disrepute with our wires overhead is simply because we have tried to get too many wires on one set of poles. We have done the work in a slovenly manner, and allowed the wires to sag. The only objection people make to overhead wires is the unsightliness of them, but it seems to me impossible to formulate such a system as would be acceptable to the municipal authorities and overcome all the objections. For instance, I am satisfied that on Broadway one electric light company has a certain number of wires which could get along with one-tenth of the wires it is using, and put the remaining wires on poles on parallel streets; and so with the telephone company. But it seems to me, that if the electric light companies were compelled to put a straight line of poles, and keep their lines at a certain distance from the telephone lines—say the electric light wires on the bottom, and the telephone wires higher up, and the telegraph wires still higher up, using both sides of the street—that would overcome all the difficulties. The way of carrying a weightless force, like electricity, is up in the air. It is much safer, much better, and the expense is much less. If telephone companies were compelled to cable their wires where they pass, they would take up very little room. I simply throw out these hints, because that looks to me to be the common-sense solution of all our difficulties.

Mr. Pope: I want to say just about two words on that point. When the underground agitation first began here in New York, I happened to be in the Traveler's Insurance Company's office, on Broadway, and the Western Union Company had just located one of their immense poles. A gentleman in the office said to me: "Look at that pole; isn't that handsome? Talk about putting your wires underground; why, I think that is an ornament, and I am glad they have put it there."

Mr. DeCamp: It is purely a case of sentiment. There is no question about that.

Mr. Bowen: When this question is solved, as it will finally be, we shall put all our wires about seventy-five feet above the ground, on iron poles, and Mr. Pope has struck the keynote of our electric light wires.

The President: I would say to Mr. Holt, that in the distribution of subjects to be considered at the next meeting, that of the Construction and Maintenance of Lines is assigned to a Committee of which he is Chairman.

I must say a word about these Philadelphia lines. Mr. De Camp has three miles of poles and forty-six miles of wire, and he carries eight hundred lamps on the forty-six miles of wire.

Mr. DeCamp: I will correct that. We have sixty-seven miles of wire.

The President: Then your figures are wrong. It doesn't make sixty-seven miles of wire when you add it up.

Mr. De Camp: Allow me here to get you straight on that. In the first place, our station is just two miles from the Delaware River. Our main lines run down to the Delaware on Chestnut and Market streets. To get at that we had to go around the public buildings. There we have a double line down. We have a line on Sixteenth street and around on Thirteenth street.

The President: On Chestnut street you carry your own poles?

Mr. DeCamp: Yes, exclusively.

The President: That is eighteen miles of wire?

Mr. DeCamp: You figure it up; I am not good at figures.

The President: I am not figuring it; I am repeating what you gave me. On two miles of poles you have eighteen wires. How much wire have you on other people's poles, and how much on your own?

Mr. DeCamp: The great bulk of our wires that are on the city poles is on one-mile poles between Thirteenth street and the Delaware on Market street.

The President: The bulk of your lines, then, is on other people's poles?

Mr. DeCamp: No; the bulk is on our own poles.

The President: You have eighteen wires on Market street. That is eighteen—

Mr. Cooper: May I rise to a point of order? Isn't the question before us that of underground wires? May I ask what connection the subject you are discussing with Mr. DeCamp has with the question before the Convention?

The President: Yes, sir; it will afford me great pleasure to answer the gentleman's question, especially when it is interjected at this stage of the proceedings. The discussion here, as to the difference between the cost of maintenance of overhead and underground lines, that you are listening to now, is relevant, so far as Mr. DeCamp's statement is concerned, that the cost of the care of sixty-seven miles of line is $1.36 a day; I think, he pays $10 a week for the linemen. I want to show, therefore, that Mr. DeCamp's statements are not statements that can be relied upon for other people, because if I can get answers to these questions straight, I can get at whether he maintains the lines, or the telephone company maintains them. What I am trying to do, as President of this Association, is to prevent any matter going on this record that will be misleading. So that, if an electric light manager charges to his labor and maintenance account just what it costs him, and then reports that as the cost of maintaining overhead lines as against underground lines; and then, when you come to analyze it, you find that somebody else is paying part of the expenses, it is my province to get up in this place, and ask these questions, so as to correct any wrong impressions that may get into the heads of members. I have a club in soak for myself just like that at home, if that statement is correct in its details. If Mr. DeCamp can run his system at $1.36 a day, when it costs me $10 a day, there will be lively times for me when I get back.

Mr. Cooper: The explanation is very satisfactory.

The President: The Market street circuit is eighteen miles, that is eighteen miles out of sixty-seven.

Mr. DeCamp: I can explain that. I did not make the statement specifically, but I presumed that every gentleman would understand that, in the five years we have been in operation, we have not been under the expense, which is inevitable, of renewing the poles, and all that sort of work. We paint our poles every year, but, rather than the city bearing any portion of the maintenance of our wires on their poles, or doing the slightest thing that will relieve us of any expense, it is quite the other way. We are compelled, as a matter of policy, to go to great expense on their account.

The President: Don't they keep the poles up?

Mr. DeCamp: They keep the poles up. I have not included in this expense any renewal of poles, but I will say this, from my experience, that we would be very glad, indeed, if we could get along without going on the city poles. I believe the expense would be decreased rather than increased. The painting of the poles I charge to the expense of line. I charge everything to the expense of line that comes to me from our storekeeper up to where the wire goes into the building. Those figures have struck me as being very low. If I have made a mistake in it, then I am doing injustice to some other items of expense which appear on our books.

The President: Now, Mr. Callender, we would be glad to hear from you.

Mr. Callender: I feel that anyone coming forward before a Society of electric light engineers to advocate the underground system, must appear at a very great disadvantage. I know perfectly well that individuals feel that all advocates of underground wires for such purposes would be better buried themselves than the wires, and it is with that feeling that I come. But no one could have come to America as I have done, without seeing these enormous poles with the cross-bars outstretched, disfiguring the architecture of your cities. I suppose that the committee have asked me to state my experience here, in order to learn what we have done in England. At the meeting of the electrical engineers,

in Philadelphia last year, my son read a paper which I suppose most of you have had, as to what had been done up to that time. During last year the spread of the incandescent light through England has been very extensive. The arc light, it is perfectly plain, is disappearing from England. I do not think that there are five hundred arc lights in existence with the exception of the few in the railway stations. They have not satisfied the English people. They have not been carried out in the way in which they should have been; and in the city of London, in the west end of London, in Liverpool, Manchester, Glasgow, in every one of those places they have disappeared, and it is only in separate installations that you find them now. Against that, however, the spread of the incandescent light is very remarkable. During the whole year, we have been as busy as we possibly could be, manufacturing mains, varying from one hundred to five thousand miles. And I think that I can speak with a little authority in this matter, when I say that the whole of the installations of the incandescent light, with a very few exceptions, laid in England, have been done by our firm. We have never had a failure. We have now had our mains laid four and a half years, and have never had a failure in England. During those four years and a half, we have not spent one single cent in maintenance. An underground system requires a material as an insulator, quite different from what some of our friends have said. There must be insulation, and good insulation, if you want a good underground system. It must be an insulator that will not be affected either by drought, or by the earth, or by dampness; that will not be affected by the sewer gases that are so common; that will not be affected by the escape of gas from the mains. Now, if you take either India-rubber or gutta-percha, and get any chemist to examine it chemically, he will tell you that all sewer gas and coal gas—that all those gases, whenever they come in contact with either gutta-percha or India-rubber, completely destroy it.

After a great many years experience in the use of bitumen—I was then introducing asphalt through Europe—after watching carefully the effect of everything upon the asphalt, I found that

it was practically indestructible. We have some utensils that were made in Egypt long, long, ago, and coated with bitumen, which have recently been unearthed, and the bitumen is as fresh to-day as it was three or four or five thousand years ago. All through the East, whenever a piece of bitumen work has been unearthed, it has been found to be perfectly unaffected by the atmosphere or by damp. In 1869 I laid a very large work in London, and very recently I took up some samples to see if there was any evaporation or any destruction of the bitumen. I found that none had taken place. I found it to within one hundred per cent. exactly as it was the day it was laid down. I then set myself to discover some means by which this bitumen could be brought into a plastic state, the same as India-rubber, and after some seven years' work I discovered what I wanted, and made what we call Bittite. We have tried it by immersion in acids, by every experiment that we could devise, and we have found nothing that takes away from it its qualities. It is necessary that in some way or other, by iron boxes or wooden boxes, or in some way, we prevent any damage taking place. We have prepared some plans showing how it can be done. This is a series of plans [exhibiting a drawing], this [indicating] is an iron box exactly the size that it would be in reality. It is made to hold fifty arc light mains, each one perfectly insulated, and each one perfectly separate from the other, and each one independent of the other. There is a bitumen bridge here let into the box at a distance of about eighteen inches from the other bridge. Ten mains are then laid in there and up to this line here [indicating] the hole is filled in with specially prepared bitumen. Upon the top of this, another row, and so on until the whole is finished. When that is finished it is as hard as a piece of granite. No acid will touch it. No outward damage can affect it at all. Then we have here a twenty box, a twelve box, a ten box, etc. Screwed on the surface of the box is a small opening with a joint screwed on there [indicating]. The cause of these plans being prepared was this: We were applied to by both the Brush Company and the United States Company to prepare a sketch for them, showing how we bring up mains from one point to another that were not to be

tapped at all. This was intended to be run from Thirtieth street east up to Fourth avenue, and from there it was to diverge. But that is a matter of detail.

MR. DECAMP: Chestnut street is a little extreme in its condition. It is not an isolated case absolutely. I find, in looking at the city plans, that on account of the water mains and the gas mains on Chestnut street, that there is only about two and a half feet square that is available for putting wires under ground.

MR. CALLENDER: Those are engineering difficulties that very little engineering ingenuity would overcome.

MR. CURTIS: Do you have any of these conduits in operation running from arc light stations?

MR. CALLENDER: No, sir. We have them in very large quantities for incandescent.

MR. CURTIS: If you cannot tap a main wire, what are you going to do when you get a new customer?

MR. CALLENDER: You can adopt a certain number of main wires. You can adopt 10, 14, 18 wires in one street. I do not think there is any place where eighteen wires are used in the same street.

MR. DECAMP: Oh, yes, we do; we are only sorry we cannot get eighteen more in.

MR. CALLENDER: I am glad to hear it.

MR. DECAMP: If we could go to the public and say there is what we have, and that is the way you must take it, we would be in an excellent position to carry out those ideas. But some one will say, I want a light from 3 o'clock to 10 o'clock, and if I cannot get that I do not want the light at all. Now the only way to solve that is to put him on a circuit that runs from 3 to 10.

MR. CALLENDER: These plans were made to meet what is presented to us. There is only one thing that I think I should like to say further. There is no use in shutting one's eyes to mistakes that have been made here. I have told you that in no case in England has any complaint ever been made for the last four years and a half. We have made one or two mistakes here, and one of those mistakes is with our friend Mr. De Camp. I think the fault lies partly on his shoulders and partly on ours,

and it is just as well to confess one's sins in anticipation. Last year Mr. DeCamp wanted to lay in Delaware avenue one mile and a quarter of double line. We supplied him with cable, guaranteeing that if he was not satisfied with it we would not ask for payment. When it came to be laid, it was found that there was an ordinance that any one putting down a box would be required to pay a tax, I think, of five cents per foot through the city. He said he intended to put in some sand and bury the cable. He thought it would be a good advertisement if it succeeded. I was induced to do that. It was put down, and I do not think it ran more than a week or two before the light gave out. That cable, I suppose, is now useless. On examining it, it appeared that some of the damage had arisen from being cut into by stone in the sand; but it is quite possible there may have been damages coming from the inside. Everything that we had laid before, and everything that we have laid since, has always been laid in protecting cases, and this in Delaware avenue is the only piece of cable we have ever laid that has been disfavored. We should not have done it. But there is the fact that that has been a failure which cost us some money; and I am afraid it cost Mr. DeCamp some money also.

Mr. Ridlon: I would like to ask the question if there can be any damage done by the expansion and contraction of the cable, that is, the expansion and contraction of the metal, and I would like to know what effect it would be liable to have?

Mr. Callender: In the first place, we do away with all solid wire. It does not make any difference how weak it is. We make the cable in sections, and the expansion and contraction are never felt at all. In cases where we want two and a half miles of incandescent lighting there is no expansion at all. We have one instance of about 20 arc lights and 500 incandescent lights for two miles and a half, the cable being in a small wooden box. That has been done for three years and a half, and there never has been one single hitch up to the day I left England. We have just finished a work where we have laid plant for 10,000 incandescent lights, and 300 arc lights to be supplied from the same. The leading main is brought on about 450 yards from the dynamo.

That main consists of ten different mains, five positive and five negative, each being composed of nineteen No. 6 Birmingham wire gauge. From that point it is distributed right around the streets, in such a system that, if any part of the wire is broken or damaged, no house would be without the light. That system has been already completed and tested thoroughly, and I had a note from Mr. Preece the other day saying that he had been over there, and he had never seen a more perfect one in his life. The whole of the Government work through the country has been done by us. We have done all the powder magazines, a good number of the ship yards, Buckingham Palace, Windsor Castle, the House of Commons and the Law Courts. We have just finished lighting up the five principal stations of the underground Metropolitan Railway, conducting cables for about a mile and a half from the distributing point.

A singular thing in England now is that all the electric light companies are disappearing. The only two left are the Edison Company and the Anglo-American Brush Company. One of the large companies has gone into bankruptcy. This resulted from the fact that in England matters were so financed that the price paid to some one for the license to form these companies was such that no company could live. For instance, the London and Metropolitan Brush Company paid £500,000 for the right of using the Brush machine. If any company can exist paying such an amount it is a mystery that has yet to be solved. I will be very glad to answer any questions.

The President: The hour of adjournment has now arrived, under the resolution of yesterday. Before adjournment, I will say that a number of subjects have been suggested for the next meeting, which will take place in February, and at which we will probably have more time for discussions. In relation to the statement made by Mr. Callender just now, it is popularly believed and borne out by the publications of the English press, that the act passed by the English Parliament has destroyed the electric lighting business more than any financial difficulty.

The subjects for discussion at the February meeting, so far, of course, as they have been selected, will be added to, and a complete list

will be published in the electrical newspapers. They are as follows:

Electricity as an Illuminant.—Messrs. Bowen, Chicago; Moses, New York; Sperry, Chicago; Cleveland, Hartford; and Holt, Cleveland.

Proper Construction and Maintenance of Wires.—Messrs. Holt, Cleveland; Dalzell, Hartford; Fahay, Boston; Duncan, Pittsburgh; Weeks, Kansas City.

Steam Power.—Messrs. Ide, Springfield; Evans, Baltimore; De Camp, Philadelphia.

Underground Lines.—Messrs. Pope, New York; Sperry, Chicago; Patterson, Chicago.

Incandescent Lighting.—Dr. Moses and others.

History and Progress of Electric Lighting.—Mr. Worthington, *Electrical Review.*

History and Progress of Electricity as Applied to Motors.—Mr. Johnston.

Electric Lighting in Canada.—Mr. Ross, Montreal, Canada.

Measurement of High-Tension Currents, Best Instruments For.—Mr. Van Depœle, Chicago; Professor Thompson, Mr. Houston, Philadelphia.

Best Equipment for Arc Lighting Stations.—Messrs. Evans, Baltimore; and Posens, Cleveland.

Operating Expenses.—Messrs. Weeks, Kansas City; De Camp, Philadelphia; Guernsey, St. Louis; O'Connor, New Orleans; Goff, New York; Tudor, Baltimore, Md.

Line Wire, Best for Overhead Lines, Size, Insulation, Etc.—Mr. Cleveland, Hartford.

Carbons and Globes.—Mr. Ridlon, Boston, and others.

Storage Batteries.—Messrs. Holt, Cleveland; and George H. Benjamin.

Motors.—Messrs. Van Depœle, Chicago; and Hochhausen, Brooklyn.

Arc Lighting.—Mr. Hochhausen, Brooklyn.

Conference Committee on the Matter of Uniformity of Prices of Apparatus and Service..—Messrs. Ridlon, Boston; Cooper, Brooklyn; Bowen, Elgin; Chase, Holyoke; Ver Nooy, Chicago;

Lyne, Jersey City; Ide, Springfield, Ill.; De Camp, Philadelphia; Smith, Peoria; Guernsey, St. Louis.

THE PRESIDENT: Gentlemen, I return you my sincere and hearty thanks for the close attention you have given to the proceedings of this Convention, and for the kindness and courtesy which you have uniformly extended to the occupant of this chair. Our intercourse has been very agreeable and pleasant, and I hope as profitable. Wishing each of you a safe return to your homes I now declare this Convention adjourned *sine die.*

MEMBERS OF THE ASSOCIATION.

New Haven Electric Company,	New Haven, Conn.
Mitchell, Vance & Co., Electroliers,	New York.
Electrical Review,	New York.
Electrical Supply Company,	New York.
Brush-Swan Electric Company of New England,	New York.
Holmes, Booth & Haydens,	New York.
Excelsior Electric Company,	Brooklyn, N. Y.
Brush Electric Light Company,	Philadelphia, Pa.
Swift Electric Light Company,	East Saginaw, Mich.
American Electric and Manufacturing Company,	New York.
Guernsey-Scudder Electric Light Company,	St. Louis, Mo.
Consolidated Electric Light Company,	Portland, Me.
Brush Electric Illuminating Company,	New York.
Day's Kerite Company,	New York.
J. A. Roeblang's Sons & Co. (Cables and Wires),	New York.
Royal Electric Company,	Montreal, Canada.
Thomson-Houston Electric Light Company,	Philadelphia, Pa.
Worcester Electric Light Company,	Worcester, Mass.
Fort Wayne Jenney Electric Light Company,	Fort Wayne, Ind.
Minnesota Brush Electric Light Company.	Minneapolis, Minn.
Jarvis Engineering Company,	Boston, Mass.
Van Depoele Electric Manufacturing Company,	Chicago, Ill.
Allegheny County Light Company,	Pittsburgh, Pa.
William L. Libby & Sons,	Boston, Mass.
Riverside and Oswego Mills,	Providence, R. I.
Callender Insulating Company,	Newark, N. J.
Poughkeepsie Electric Light and Power Company,	Poughkeepsie, N. Y.
Schuyler Electric Light Company,	Hartford, Conn.
Electric Light Company,	Hartford, Conn.
Springfield Electric Light Company,	Springfield, Mass.
Pittsburgh Carbon Company,	Pittsburgh, Pa.
Thomson-Houston Electric Light Company,	Norwich, Conn.
Ball Electric Light Company,	Reading, Pa.
Steam Supply and Electric Light Company,	Springfield, Ill.
Morss & White Wire Company,	Boston, Mass.
Daft Electric Light Company,	Greenville, N. J.
North Adams Electric Light Company,	North Adams, Mass.
Bridgeport Electric Light Company,	Bridgeport, Conn.
Holyoke Electric Light and Power Company,	Holyoke, Mass.
Brookline Electric Light Company,	Brookline, Mass.
Electric Light Company,	St. Paul, Minn.
La Crosse Electric Light and Power Company,	La Crosse, Wis.
Star Iron Tower Company,	Fort Wayne, Ind.
Electrical Supply Company,	Chicago, Ill.

Russell Mining and Manufacturing Co.,	St. Louis, Mo.
City Electric Light Company,	Kansas City, Mo.
City Electric Light Company,	Cleveland, O.
pal Electric Light Company,	Brooklyn, N. Y.
Electric Illuminating Company,	Albany, N. Y.
am Isolated Plant,	New York.
y & Co., Electroliers,	New York.
n Company (Limited),	New York.
Electric Light Company,	New York.
lectric Light Company,	Elgin, Ill.
t & Burnham,	Waterbury, Conn.
Electric Light Company,	Boston, Mass.
Carbon Company,	Cleveland, O.
ton & Sims Engine Company,	Providence, R. I.
d Underground Cable Company,	Pittsburgh, Pa.
Bluffs Electric Light Company,	Council Bluffs, Iowa.
lectric Company,	Boston, Mass.
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ghouse, Church, Kerr & Co.,	New York.
ort Brass Company,	Bridgeport, Conn.
a Brass and Copper Company,	New York.
City Carbon Company,	Cleveland, O.
n Electrical Supply Company,	Baltimore, Md.
Electric Light Company,	Baltimore, Md.

Names of Gentlemen attending the Meetings of the Convention.

J. F. Morrison, Brush Company, Baltimore, Md.
F. W. King, Brush Company, Baltimore, Md.
George S. Bowen, Elgin Company, Elgin, Ill.
E. A. Sperry, Sperry Company, Chicago, Ill.
E. R. Weeks, Thomson-Houston Company, Kansas City, Mo.
William Hochhausen, Excelsior Company, Brooklyn, N. Y.
George D. Allen, Excelsior Company, Brooklyn, N. Y.
Charles Dustin, Schuyler Company, Hartford, Conn.
H. M. Cleveland, Schuyler Company, Hartford, Conn.
Charles Cooper, Municipal Company, Brooklyn, N. Y.
Frank Ridlon, Brush-Swan Company, Boston, Mass.
P. Fahay, Brush-Swan Company, Boston, Mass.
S. A. Duncan, Brush Company, Pittsburgh, Pa.
James Jepson, Thomson-Houston Company, Norwich, Conn.
A. J. Holt, Brush (parent) Company, Cleveland, O.
C. C. Curtis, Brush (parent) Company, Cleveland, O.
W. W. Leggett, Detroit Company, Detroit, Mich.
E. J. O'Beirne, Star Company, Fort Wayne, Ind.
J. F. Upton, Jarvis Company, Boston, Mass.
J. F. Noonan, Paterson Company, Paterson, N. J.
Thomas Officer, Council Bluffs Company, Council Bluffs, Iowa.
John J. Moore, Springfield Company, Springfield, Mass.
W. H. Baker, American Company, New York.
W. J. Jenks, American Company, New York.
A. J. Elder, American Company, New York.
E. A. Goff, American Company, New York.
Henry C. Carman, Tesla Company, Rahway, N. J.
R. J. Winchester, Holyoke Company, Holyoke, Mass.
A. DeCamp, Brush Company, Philadelphia, Pa.
F. H. Gilbert, New Haven Company, New Haven, Conn.
James English, New Haven Company, New Haven, Conn.
H. C. Adams, Holmes, Booth & Haydens, New York.
M. E. Baird, Holmes, Booth & Haydens, New York.
C. B. Hotchkiss, Day's Kerite Company, New York.
W. O. Callender, Insulating Company, Newark, N. J.
H. Thayer, Western Company, New York.
F. Harrington, Western Company, New York.
Charles Rolfe, Western Company, New York.
H. B. Lytle, Lytle & Co., New York.
G. L. Beetle, Lytle & Co., New York.
G. W. Parker, Parker-Russell Company, St. Louis, Mo.
L. M. Fishback, Parker-Russell Company, St. Louis, Mo.
D. H. Tuxworth, Southern Company, Baltimore, Md.

. S. Garrett, Southern Company, Baltimore, Md.
. L. Ide, Ide Company, Springfield, Ill.
eorge F. Porter, Pittsburgh Company, Pittsburgh, Pa.
eorge Wadsworth, Boulton Company, Cleveland, O.
. L. Libbey, Globes, Boston, Mass.
. D. Stanley, Brass Works, Bridgeport, Conn.
———— Nicholson, Ball Company, Reading, Pa.
. W. Spang, Ball Company, Reading, Pa.
———— Coggeshall, Mitchell, Vance & Co., New York.
eorge L. Wiley, Waring Cable Company, New York.
ajor D. P. Heap, Secretary United States Lighthouse Board, Washington, D. C.
ieutenant J. Millis, in charge of Hell Gate Improvements, New York.
lfred Moore, Wire Company, Philadelphia, Pa.
eorge A. Mayo, Mayo Company, Boston, Mass.
W. C. Kerr, Westinghouse, Church, Kerr & Co., New York.
G. M. Smith, Ansonia Company, New York.
J. B. Sheriff, Sheriff, Son & Co., Pittsburgh, Pa.
H. L. Brintnall, East Saginaw, Mich.

PROCEEDINGS

OF THE

NATIONAL

ELECTRIC .·. LIGHT .·. ASSOCIATION,

AT ITS

SECOND ANNUAL CONVENTION,

FEBRUARY, 1886.

HELD AT BALTIMORE, MD.

BALTIMORE:
THE BALTIMORE PUBLISHING COMPANY,
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1886.

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A. J. De CAMP, - - - *Philadelphia, Pa.*

PROCEEDINGS

— OF THE —

NATIONAL ELECTRIC LIGHT ASSOCIATION

— AT THE —

SECOND ANNUAL CONVENTION.

FIRST DAY'S PROCEEDINGS.

CARROLLTON HOTEL, BALTIMORE, Feb. 10, 1886.

The Convention was called to order at 12 M. by the President of the Association, Mr. J. F. Morrison, who addressed the Convention as follows:

GENTLEMEN:

The success which our Association has already achieved must be very gratifying to its founders and well-wishers. This well-earned fruit is the reward of the toil and trouble bestowed upon it. Its numbers, its popularity, and its usefulness have, indeed, grown with lightning-like rapidity. From the small group of men gathered together in the parlors of the Pacific Hotel, at Chicago, one year ago, it has grown to an Association numbering hundreds of members, and its influence has already been felt through all the ramifications of the electric lighting business. We meet here upon the floor of this Convention as the scientist and the practical man. The former indicates the course along which

the latter may walk and achieve such results as past history promises to the future. Baltimore extends to you a welcoming hand; and permit me to say now that its history, as relates to electrical matters, is fraught with unusual interest. Nearly all the practical applications of electricity, such as the telegraph, the telephone, the electric light, the electric locomotive, &c., have either found their birth, or, to some extent, their fruition in this city.

You have in this room to-day among those who will give you a hearty welcome and extend the hospitalities of a city renowned for its liberality and broad views, Maryland's Representatives in Congress, members of the State Legislature, and the Chief Magistrate of the city of Baltimore.

At our last meeting, held at the Hotel Dam, in New York, a distribution of the subjects presented to that Convention was made to various committees, upon whose reports and the accompanying papers you will be called upon to pass during the present session. Among the most important (to my mind) will be the discussion upon "Electricity as an Illuminant," "Arc *versus* Incandescence Lighting," and "The Feasibility of Placing Electric Wires Underground" We will also have the very important matter of "Operating Expenses" to discuss, as well as "The Relation of Electric Lighting to Insurance." The names of Dr. Otto Moses, Prof. George H. Benjamin, Major Heap, of the United States Navy; Mr. E R. Weeks, of Kansas City; Ralph W. Pope, George Worthington and C. J. H. Woodbury, of New York, are a sufficient guarantee of the intelligent manner in which these subjects are likely to be discussed.

Among those who have accepted invitations to be present are Prof. M. A. Newell, Principal of the State Normal School and State Superintendent of Public Instruction; Henry A. Wise, Superintendent; John E. McCahan, Assistant Superintendent of Public Instruction of Baltimore city; and Henry A. Rowland, of the Johns Hopkins University, whose reputation as an authority in electrical matters is not confined to his own country, but is well known wherever the subject of electricity is intelligently investigated; Ensign Louis Duncan, United States Navy, Chairman of the Committee on the Life Tests of Incandescent Lamps and Dynamos, appointed by the Franklin Institute, of Philadelphia. Prof. Kimball and Dr. Perkins, of the Johns Hopkins University, have also been invited. These gentlemen during the session will, I have no doubt, offer many valuable suggestions from the broad experience gained through scientific investigations of the electrical field.

I would ask from the members present the closest attention to the matters under discussion at this meeting.

I now have the honor to introduce to you the Hon. James Hodges, Mayor of the city of Baltimore, whose name has been for

nearly half a century identified with everything beneficial to our great city; one who not only encourages progress, but keeps along, step by step, by her side; one whose words of welcome come not merely from the lips, but are the genuine expressions of the heart—the great heart of the hospitable people of Baltimore.

MAYOR HODGES: As Mayor of Baltimore, I extend to the delegates of the National Electric Light Association a sincere and cordial welcome to this city. As it is one of geographical centrality, whose inhabitants are proverbially kind-hearted and hospitable, I deem it not egotistical to remark that the place of your meeting is well chosen. I am only repeating a platitude when I say that safety to life and property, and good living and good cheer are among the distinguishing characteristics of this community, and I underwrite this bond to you. While among us, the eyes of our women will illuminate your pathway by day, and our electric lights will perform for you a similar service at night. With such all-pervading radiance around you, the proceedings of your Convention cannot be otherwise than brilliant.

The people of Baltimore cannot but feel a lively interest in the questions to be discussed in this Convention. It was here, in 1844, that Morse first brought into successful operation his telegraphic line, connecting this city with Washington. No grander result can ever be achieved by human genius over space and time. I witnessed its first operation at this end of the line, in a brick building which stood on a small part of the ground now occupied by the City Hall, with a feeling of awe and wonderment, from which I have never recovered. A few days afterwards I went to Washington with some friends on a visit, and was introduced to Prof. Morse in his office at the Capitol. He explained his ingenious invention to us with a display of enthusiasm which was as child-like as it was delightful. I shall never forget the expression of joy that illuminated his genial face as he talked over the apparatus. The Baltimore *Sun* was the first newspaper in the world to make use of the electric telegraph. It was here, in 1848, that George B. Simpson exhibited the first successful sub-marine telegraph, the one now in practical use by all telegraph companies. It was here, in 1878, that the first practical test was made between the original Bell telephone and the Edison carbon transmitter, which resulted in favor of Edison, and brought about the consolidation of the two interests. Baltimore was the second city on the American continent, in 1881, to apply, on a large scale, the system of electric lighting to its public thoroughfares; and the first, in 1885, to equip and put into successful operation the electric railroad, which connects the village of Hampden with this city. Hence, as I have before intimated, the place of your meeting is most appropriately

chosen. You have assembled here to develop and promote a science of great utility to the world, which, in my judgment, is only in the infancy of its application to the necessities and comforts of mankind. As a means of protecting life and property, the system of electric lighting is only second in efficiency to an honest and efficacious police. Men are deterred from committing crimes under the glare of electric lights, though seemingly alone, for fear that some one from a distance, screened from view, may be looking on. An electric light is a nocturnal joy to an honest man, but a scarecrow to a thief. I never shall forget the thrilling impression made on my mind by the first electric light I ever saw. It was in Paris, in 1878, that I first beheld the display of this wonderful invention. The Arc de Triomphe, the crowning glory of the Champs Elysees, was surrounded by electric lamps, and the great white marble memorial to Napoleon Bonaparte was made to shine in the distance like a beacon of hope. The sight was captivating to my senses, and I thought I had never witnessed a more remarkable effect produced by means of illumination. But a still greater delight awaited me, and I realized it when I saw the Avenue de l'Opera at night, one of the most magnificent streets in the world, illuminated by long ranges of electric lights in ornamental lanterns mounted on lofty artistic lamp-posts. No language could describe the enchanting brilliancy of the scene. It is still one of the attractive sights of Paris, and I continue to think of it with unabated wonder and delight. Since that period, as you know with much greater particularity than I do, the uses of the electric light have become greatly enlarged, diffused, and diversified. Not only night building, but night harvesting, can be carried on successfully when necessary. This was demonstrated in France as early as 1878, by means of a movable Gramme machine, which illuminated the field while the harvest was progressing.

I will not venture to be instructive to this intelligent body of scientists, at whose feet I might sit to study the principles and appliances of electricity, but I will ask your indulgence so far as to say, what doubtless you already know, that recently the electric light has been utilized as a means to aid medical and surgical diagnosis, and to assist by its internal application to illuminate the various dark cavities of the human form, which surgeons and physicians have had no previous means of exploring. This has been accomplished by the invention and application of an ingenious little electric light supplied from a small portable battery. The light is perfectly insulated by a thick glass covering, and is attached to a convenient handle. This invention has been successfully used in assisting the laryngoscopist in making a more perfect and satisfactory examination of the throat and posterior nasal openings. This little instrument, when held in

the mouth, with the lips closed, will illuminate the entire face so thoroughly as to bring to light all tumors and other morbid growths which may be located in the deep cavities thereabout. Besides having been used with advantage in both uterine and rectal surgery, we are told that Bilroth, the eminent Vienna surgeon, has affixed this small electric light to a long flexible handle, and has actually passed it down into the stomach, illuminating it sufficiently for the detection of disease. But I will not talk to you any longer about a matter which you understand much better than I do. I will simply renew my best wishes for the success of your Convention, and for the best possible mixture of social and intellectual enjoyment for yourselves while sojourning in our city. I would be pleased to see you all at the City Hall before you take your departure from Baltimore.

THE PRESIDENT: The next business in order is the calling of the roll, but, owing to the late arrival of many of the members of the Association, it has not yet been prepared by the clerks. I will, therefore, request Mr. Weeks to present his paper on "The Proper Construction and Maintenance of Circuits;" and at the evening session of to-day I hope we will have these other arrangements perfected.

MAYOR HODGES: Pardon me for retiring so soon after my address to you; but my duties at the City Hall are urgent, and I must see some persons who want to speak to me on business of great importance to themselves.

The Mayor then withdrew from the Convention.

MR. H. W. POPE: If it is in order, I would like to offer a resolution. The reason I do this is because the committee will have to take some action to-day in order to make a report.

THE PRESIDENT: I would ask Mr. Pope to delay the presentation of this business until the Convention is in better working shape, which will be this afternoon, when it will come up in its regular place. There will be no trouble about the appointment of the different committees. And here I will state the difficulty which arose at the last Convention. Committees were appointed on all these various subjects. A few have discharged the duties imposed on them, and fewer of

them are present at this meeting. I have telegrams from a great many saying that they will be present during to-day or to-morrow. This is the reason of the delay in the proper organization of the Convention.

MR. POPE: All right, sir.

THE PRESIDENT: Mr. Weeks will read his paper.

MR. WEEKS: It may be well to say that this subject was referred to a committee, of which I was one. Owing to the recent death of the chairman of the committee, I have been asked to start the ball rolling. This is all I have presumed to do in this paper.

As the subjects of "Underground Conduit" and "Incandescence Lighting" were assigned to other committees, the following notes will apply to ærial arc circuits only.

Under the head of construction may be considered line-wire, supports, lamps and station connections; under that of maintenance, lines, lamps and dynamos. Since the important subject of line-wire was given to another committee, *its* discussion is omitted.

To guard against "trouble," and to facilitate its removal, the line should, as far as possible, be in sight from the ground, and be so placed as to be readily reached. By such construction, trouble and the cost of attendance are reduced to a minimum, and one is freed from the endless complications of house-top work, with its manifold objections—*i. e.*, rights to be begged, bought or stolen; vexatious delays in removing "trouble;" costly repairs to roofs, chimneys and fire-walls, together with all the thrilling adventures of a Boston lineman.

On some narrow and over-crowded streets it may be policy to erect iron standards; but the danger of fire and of ground shocks is so great with such supports, that those of wood are much to be preferred.

To prevent the cutting of insulation by tie-wires and to guard against excessive slack from stretching, poles should not be more than one hundred feet apart. With the best material and good workmanship, and by paying more attention to the general appearance of the line, we may gain in efficiency, and do much toward silencing the outcry against overhead wires.

Aside from the necessity to comply therewith, the rules of the Board of Underwriters should be observed, because they are founded in reason, and are *generally* conducive to the interests of all parties. There *must* be a positive "cut out" on every loop. But, instead of placing it upon the building containing the lamps to be cut off, it has been found better to provide for it a special pole or support, as near as possible, of course, to the entrance to

the building, but independent of it or of any structure which is likely to be destroyed by fire. By so doing, control of the circuit is retained in the event of the total destruction of the building containing the loop. There have been instances where such an arrangement would have saved the circuit and prevented loss from rebate. Where high tension currents are employed, porcelain should not be used for outside insulation. The best insulators for this service are of hard rubber and of glass. By means of wall-blocks and brackets, rubber hooks and glass insulators may be used for all outside work where it is common to employ porcelain knobs.

In entering buildings additional insulation of hard rubber tubing should be used. To avoid damage from water, entrance holes should be bored upward from the outside, and the wire run from a fixture placed below the exterior opening, so that all drip shall be away from the building. For like drainage purposes, glass insulators should be set at an upward angle and rubber hooks pointed downward.

Lamps should be suspended by some perfect insulator, vulcanized rings being the best known to our experience. The best service is given by stationary lamps. This is especially true of outside lights. Those hung with raising and lowering tackle are more liable to wear, breakage, and variable contacts than are rigid lamps; and in cold weather the tackle may become so clogged with ice as to render them inaccessible. For like reasons, when it is necessary to place the light toward the middle of the street, some device similar to the Brady mast-arm will prove most satisfactory.

Hoods should be sufficiently large not only to protect the lamp from the weather, but to allow access to its works while it is in service. The conical form, since it offers least resistance to the wind, is preferable to other shapes.

Globes should be deep enough to cover the arc when the lamp is trimmed full; and the aperture at the top should be no wider than will just allow the rod and holder to pass freely.

The dynamo-room should be a clean, dry, well-ventilated apartment. In no other can electrical machinery be kept in a condition to do the best and most reliable work. Let every dynamo be set on some sort of frame, by means of which the tension of the belt can be easily changed; and in addition, let it be carefully insulated from this frame by blocks of paraffined wood, or some other equally good insulation. Wires from the machine to the switch-board are best run either by way of the ceiling or beneath the flooring. Under no circumstances should they be laid upon the floor, where they are not only in the way, but are sure to lose their insulation through dirt and wear.

All station wires should be cased in rubber tubing as high as a man's head, and cables and lines connected with the switch-boards must have similar coverings to guard against short circuits, fire, and injury to employees. To protect both machines and lamps, and the property of patrons, every circuit ought to have lightning arresters at the station—one on each wire.

The proper maintenance of lines requires that all other wires be excluded from electric light poles. The apparent economy of partnership poles is more than offset by the increased care required to maintain lines in good condition. Such a combined system will result in greater danger of crosses and grounds, fires will be more frequent, and the lives of men unacquainted with the handling of electric light wires will be jeopardized.

The insulation of circuits should be tested several times daily, and all lines patrolled frequently. In searching for grounds and in repairing open circuits, much time may be saved by using a magneto. Having attached the two wires of the open circuit to the station bell-box, the lineman, with a duplicate magneto, goes to the break. When the wires are ready for connection, he uses the magneto to signal the station that the current may be turned on in five minutes, or some other previously determined period. In this way a search for a telephone, or a walk to the station, will be avoided and rebates will be reduced.

Dirt must not be allowed to accumulate on any part of the lamp. Rods, bases, switches, contacts, bushings, and globes should be kept clean, and screws well set. Rods require frequent burnishings with crocus cloth. Let there be a system of rigid inspection at varying intervals, and full and exact reports from the inspector as to the work of each lampman.

If properly tended, lamps need very little adjusting. In nine cases out of ten, adjusting simply means cleaning. But one man should attend to the adjustment of any set of lamps; and these, if properly cared for by the lampman, ought to run for a long period, with little other attention. As often as once in two years, at least, it is well for the lamps to be returned to the station to receive a thorough overhauling, and to be repainted, that they may present as creditable an appearance as possible.

In the annual contract with the consumer, there should be a clause especially stating that any working with the lamp by other than electric light employees will relieve the lighting company from all responsibility for failure of light. Employees should be provided with badges worn in plain sight.

Machines run in series do not give as good results as when run singly. The tension is increased to the danger point, while oscillation and all other kinds of trouble are more difficult to overcome.

The insulation of dynamos must be tested as often as is that of the outside circuit, and all circuit connections and binding-post screws must be kept tight.

Having given the machine the most favorable setting, it still needs intelligent attention to maintain it in an efficient condition. Except in an unusual emergency, the necessity for calling an expert will generally mean that the machine has not had proper care. The insulating parts will probably be found greasy and gummy and coated with metallic dust, which destroys insulation, and causes trouble of various kinds.

In conclusion, it may be said that if circuits are properly constructed and cared for, they should work satisfactorily. If they do not do so, if they are in constant need of repairs, if lamps require frequent adjustments, if bushings are continually burning out, the *meaning* is careless attendance; and of all this carelessness, failure in cleanliness will be found the most common fault. Given a well constructed circuit, cleanliness is the ounce of prevention that will obviate ninety per cent. of the vexations of electric lighting.

MR. COOPER: There is only one point in the paper to which I would like to call attention; that is in regard to having poles 100 feet apart. We are putting them 200 and 250 feet apart. If we put them 100 feet apart we think they look like a picket fence.

MR. WEEKS: I attempted to give the reasons for that construction. I think they are manifest to members who have had any lengthy experience in the maintenance of lines. The insulation is very easily cut at the tie-wire. In order to prevent that we should use as large a tie-wire as we can, and have as large an insulator as practicable, so that we may have as large a bearing for the line and, above all, have the supports as near together as possible. I know it is common to stretch out the pole, and in some cases it is absolutely necessary. In cases where you cannot construct in any other way long spans are necessary. But I think it is advisable in most cases to shorten the length of the span.

MR. KING: The paper just read opposes the suspension of lamps over the street. I want to say that in Minneapolis we are running some 225 lights suspended over the centre of the street, at intersections, by means of a sheave, pulley and winding drum. We have been

running some of them now for a year. We have a great many zephyrs in the air there at this season of the year, and some times the thermometer gets down into the basement. I want to say that we have never experienced any trouble. Our lamps are very satisfactory indeed. We consider it a very much cheaper and preferable way. We are very much pleased with the system.

Mr. Cooper: In what way is it cheaper?

Mr. King: It is cheaper by being more effective. The apparatus which we use is the invention of a Minneapolis man. It costs us about six dollars, and I think that is less than any price I have ever heard of. It seems to me it is preferable.

Mr. Cooper: The cheapness is in the construction.

Mr. King: So far as attendance is concerned, we have had no expense from that whatever. We hang our lamps so that with our apparatus they can be lowered within 12 feet of the street and a carriage can pass by the lamp without striking it. It also furnishes facilities for adjusting the lamp while the current is on.

Mr. Cooper: How long does it take a man to trim one of those lamps?

Mr. King: We have trimmers who, with a ten-foot step-ladder, can travel probably six miles and clean 40 to 50 lamps in a day.

Mr. Cooper: That is about half as much as they generally trim, isn't it?

Mr. King: Of course they trim many more store lamps.

Mr. Cooper: On a stationary pole they can trim more?

Mr. King: I never had any experience in that.

Mr. Cooper: We have trimmed 75 to 90 lamps on stationary poles; therefore, ours is cheaper. We have circuits ten miles, which are, I think, the largest in the country. A circuit of ten miles is only five miles in length.

Mr. King: Can you tell me where I can hire one of those fellows?

Mr. Linnell: I would like to ask whether using the apparatus of which he speaks renders it necessary to use any connecting apparatus across the street?

Mr. King: Yes, sir. We set two poles. We run a telegraph wire across from pole to pole, and on the wire we put a double sheave pulley. The upper sheave runs on this supporting wire, and the cable which suspends the lamp runs through the lower and back to the winding coil.

Mr. Linnell: We find that, especially in the East, there are a great many city councils who, for some reason or other, have objections to wires running across the street on account of processions or carnivals. They require the erection of poles fifty to sixty feet high in order to avoid any danger from high cars or anything of the kind coming into contact with the wires.

Mr. King: I think it is the case in all Western cities, and I presumed it was the same in the East, that circuit wires cross the street by intersections. Our lamps are hung above the level of the other wires, and should a carnival get in the way, various other companies would also be affected—the Telephone, the American District and the Telegraph.

Mr. Ridlon: I think the greatest objection to stringing a lamp diagonally across the street, is that of accident. Now a lamp weighs from 50 to 65 lbs. I have known a number of cases in which in moving the lamp backwards and forwards the wire running across the street became so much worn that the lamp would fall. This has been very strongly objected to by a great many people, especially of the New England States. In Worcester they have had one or two accidents of that kind, and they have gone to the expense of building a sort of iron tramway across, that is capable of supporting at least two or three hundred pounds, on which the lamp is put.

Mr. King: I would say in reply that with our system we have a double support. The upper wire which carries the sheaves and pulley is the first. In addition to that we have a quarter inch iron wire rope, which we think makes it entirely safe.

Mr. Cooper: I would just state here that I have had a little experience with just that same kind of apparatus. It is the Brady mast-arm. We had two poles with the tackle of which you speak which broke and injured some persons, costing us $1,500. With this system of a mast the light is suspended from the middle, and then if a procession goes by the mast stands out of the way. The whole expense is about $20.

Mr. King: So far as we are concerned, we have given this matter now about a year's trial. We have used the lamp, and I think we can swing 500 lbs. weight on the galvanized wire. We have not had the slightest trouble, and do not anticipate any. After giving the matter careful attention, we think that is a preferable plan. It gives us the light exactly where we want it.

The President: With the construction carefully attended to, there ought to be no danger whatever from the plan suggested. The objections made by Mr. Cooper have been recognized in every place where that plan is adopted. But you have a number of unsightly wires across the street. I have heard that they are content to kill a man in Brooklyn, but they are not willing to have the streets disfigured by many wires.

Mr. King: I want to take the census before we kill a great many of them. We have only two wires across the street, except our line wire, which runs out to the lamp.

Mr. Cooper: You must have the two supporting wires and the lighting wires.

Mr. King: I think I will have a model of that system here before the Convention closes.

Mr. Cooper: I have had experience with both plans, and I find one satisfactory and the other not.

Mr. Weeks: I have had experience with both, and I have conferred with a great many who have had a like experience. I think the matter may be summed up right here. The cost of construction is less with a lamp on a pole, or by the use of the Brady mast-arm set out in the street. The cost of maintenance has been shown to be less. So, as we have a more economical

construction, and more economical maintenance with one system, it seems to me that the other must fall to the ground. The objections to the other have been set forth pretty clearly. In addition to that, I may say that occasionally it is necessary to move a house, and if that is done you must take all your tackle down. I know a case where a man, becoming angry with the wire companies, got a seventy-five foot derrick, which he hauled up and down the street in order to keep them moving their wires from one place to another.

MR. COOPER: There is one other objection, which is a very serious one with us. When we pull out a lamp, frequently the carbons slide by, and it is necessary to pull it in again.

MR. KING: We have not had that trouble, and we do not have a man with a derrick or a brass band parading our streets. Occasionally we have a house moved; though, as a rule, they are well pleased when they get located, and stay right in one spot. I think the gentleman is wrong as to the first cost of this apparatus. The cost to us is the cost of the drum, the sheave, the wire rope, the piece of telegraph wire, and one pole. It is not expensive in our country.

MR. WEEKS: There is another objection, Mr. President, that seems to have been overlooked. I mentioned it in my paper, and it was my chief objection to that system. I speak of the liability to variable contacts. I have noticed in circuits where those lamps are used that there is an unsteadiness that may be done away with entirely.

MR. KING: Growing out of what?

MR. WEEKS: Growing out of variable contacts. It is almost impossible to keep your leading wires to the circuit tight in your binding-posts. The man may, when he lowers the lamp, tighten it as much as possible, but, in raising the lamp, the wires will wear loose, causing a variable contact and trouble in the circuit.

MR. KING: We have not met with that trouble in our experience.

MR. WEEKS: I think you have. I saw your light.

MR. KING: What time of the night? [Laughter.]

Mr. Smith: We could not go to the expense of erecting the masts of which the gentleman speaks. We put a mast across the centre of the street in that way. We put one cable across the street. Our trustees objected to putting poles in the street, so we suspended the cable on the tops of the buildings and fastened a single sheave block in the centre of it, taking the lamp wires from the building to the lamp. We put the wires to binding-posts, turned them around so they could get out, and we had no trouble at all with variable contacts. There is no necessity of any winding drum. All we need is a hook. A man gets on the step-ladder, lowers his lamp, and the swing of the wires draws the lamp right on the sidewalk and he is out of the dirt, the way of carriages, and everything else. I don't see any necessity for any apparatus such as this gentleman here has spoken of; and I am of the opinion that it is better to have lamps in the centre of the streets.

Mr. Cooper: It may not be an objection in the country, but it is a very serious one in the city, because places of business close up at six o'clock, and a man would not be able to get at his wires on the tops of buildings after that hour. We are talking of running wires on the streets, not on the house-tops.

Mr. King: If the Convention will bear with me— We first began with a rope, which we wound, as the gentleman suggests. It occurred to us that any one, if so disposed, might get up there and let our lamps down. Now we have a ratchet, and when the crank is pulled out it takes some other crank—we have lots of them, of course—to unwind it. We consider it reasonably safe.

The President: The Secretary is prepared now with the reports of the Secretary and Treasurer.

SECRETARY'S REPORT.

The Secretary of the "National Electric Light Association" begs leave to make the following report of receipts and expenditures:

1885.	Receipts:		
Aug. 23	Balance in hands of the Treasurer..		$ 168 38
Sept. 2	Fitchburg Steam Engine Co.........	$ 10 00	
Oct. 3	Holyoke E. L. and Power Co.......	10 00	
" 3	The Thompson-Houston E. L. Co., Philadelphia.......................	10 00	
" 3	John A. Roebling, Sons & Co........	10 00	
" 3	Pittsburg Carbon Co..................	10 00	
" 6	H. C. Adams, *Agent* of Holmes, Booth & Hayden..................	10 00	
" 7	Jarvis Engineering Co...............	10 00	
" 7	Mitchell, Vance & Co................	10 00	
" 7	Ansonia Brass and Copper Co..... .	10 00	
" 8	Parker-Russell Mining and Manufacturing Co........................	10 00	
" 8	Brush Electric Co., Cleveland, O...	10 00	
" 8	Callender Insulating and Water-Proofing Co..........................	10 00	
" 9	Western Electric Co., Chicago	10 00	
" 9	Kansas City E. L. Co., Kansas City.	10 00	
" 9	Worcester E. L. Co., Worcester, Mass..................................	10 00	
" 9	Washburn & Moen Manufacturing Co, New York......................	20 00	
" 10	Boulton Carbon Co., Cleveland......	10 00	
" 14	Westinghouse, Church, Kerr & Co.	10 00	
" 14	Benedict & Burnham Manf'g Co...	10 00	
" 14	Bridgeport Brass Co..................	10 00	
" 14	American Electric Manufacturing Co., New York.	10 00	
" 14	The Royal Electric Co., Montreal...	10 00	
" 14	Brush Electric Co., Baltimore.......	10 00	
" 15	Armington & Simms Eng. Co., Providence, R. I......................	10 00	
" 15	Fort Wayne Jenny E. L. Co., Fort Wayne................................	10 00	
			$260 00
	Amount carried forward...................		$428 38

	Amount brought forward.....................		$428 38
Oct.	15—Starr Iron Tower Co., Fort Wayne.	$10 00	
"	16—Municipal E. L. Co., Brooklyn......	10 00	
"	19—Minnesota Brush E. Co., Minneapolis..................................	10 00	
"	20—Forrest City Electric Works, Cleveland..................................	10 00	
"	24—Wm. L. Libby & Sons, Boston......	10 00	
"	29—Clark B. Hotchkiss, *Agent* A. G. Day.	10 00	
Nov.	2—Indianapolis Brush E. L. Co.........	10 00	
"	11—Guernsey & Scudder E. L. Co., St Louis..................................	10 00	
"	11—Electrical Supply Co., Chicago......	10 00	
"	13—Ball Electric Manf'g Co., Reading.	10 00	
"	25—Allegheny Co. Light Co., Pittsburg	10 00	
Dec.	18—Elgin E. L. Co., Elgin, Ill..........	10 00	
"	18—New York Insulated Wire Co., N.Y.	10 00	
1886.			
Jan.	16—Morse and Whyte, Boston............	10 00	
"	16—R. W. Pope, New York................	10 00	
"	14—The Electrical Supply Co., N. Y...	10 00	
"	14—New England Butt Co.	10 00	
"	15—Bridgeport E. L. Co., Bridgeport..	10 00	
"	15—Riverside and Oswego Mills, Providence, R. I..........................	10 00	
"	15—Brush E. L. Co., A. J. De Camp, Philadelphia......	10 00	
"	15—Brush E. L. Co., Cleveland, O......	10 00	
"	18—Domestic Light, Heat and Power Co., A. S. Jones....................	10 00	
"	18—New Haven E. L. Co., J. English...	10 00	
"	18—Newport Ill. Co., J. English........	10 00	
"	20—Brush E. Illuminating Co., N. Y...	10 00	
"	25—Fitchburg Steam Engine Co.........	10 00	
"	25—Lewiston and Auburn E. L. Co., Auburn, Maine....................	10 00	
"	25—Pilcher Council Bluff E. L. A., Council Bluffs......................	10 00	
"	25—Swift E. L. Co., East Saginaw......	10 00	
"	30—W. L. Libby & Sons, Boston	10 00	
Feb.	2—Vitrite and Luminoid Co., N.Y......	10 00	
"	2—Shultz Belting Co., St. Louis.......	10 00	
"	2—C. McIntyre & Co., Newark..........	10 00	
"	3—McKeesport Light Co., McKeesport.	10 00	
"	3—Taunton E. L. Co., Taunton, Mass.	10 00	
			$350 00
	Amount carried forward.......		$778 38

	Amount brought forward		$778 38
Feb.	3—Brown Electric Co., Pittsburg	$20 00	
"	3—Onega Manf'g Co., New London	10 00	
"	4—Biernstein E. L. Manf'g Co., Boston.	10 00	
"	4—Jamestown E. L. Works, Jamestown, N. Y.	10 00	
"	6—Chemical E. L. & P. Co., Boston	10 00	
"	8—Southern Electric Co., Baltimore	10 00	
"	8—Viaduct Manf'g Co., A. H. Bauer, Baltimore	20 00	
"	9—F. E. D. Cator, Boston	10 00	
"	9—New Bedford E. L. Co., Samuel C. Hart, New Bedford	20 00	
"	9—D. H. Dorsett, Chicago	20 00	
"	9—Waterhouse E. L. and Manf'g Co., Hill Cleveland, Hartford	10 00	
"	9—Electrical World, C. E. Stump, T. C. Martin, New York	20 00	
"	9—St. Joseph E. L. Co., J. A. Corby, St. Joseph, Mo	20 00	
"	10—Bishop Gutta Percha Co., Henry A. Reed, New York	10 00	
"	10—St. Louis T. & H. E. Co., Lill Fishback, St. Louis	10 00	
"	10—Brush E. L. Co., W. H. Fitzgerald, Detroit	10 00	
"	10—Patterson, E. L. Co., J. F. Noonan, Patterson	10 00	
"	10—U. S. Illuminating Co, E.T. Lynch, Jr., New York	20 00	
"	10—American Electrical Works, Eugene Phillips, *President*, Col. Beetle.	20 00	
"	10—Albany E. Illuminating Co., Edw. A. Maher, Albany	10 00	
"	10—Riverside and Oswego Mills	10 00	
"	10—Arthur Stewart	20 00	
"	10—Chemical E. L. & P. Co	10 00	
"	10—Taunton E. L. Co., W. S. Mitchell, Taunton	10 00	
"	10—Schuyler E. L. Co., Hartford	10 00	
"	10—Hill Linnell	10 00	
"	10—West Electric Co	10 00	
"	10—Ansonia Brass and Copper Co	10 00	
"	10—St. Louis T. & H. E. Co., Lill Fishback	10 00	
			$380 00
	Amount carried forward		$1,158 38

	Amount brought forward..................		$1,158 38
Feb.	10—H. C. Adams, *Agent*....................	$10 00	
"	10—Brush E. L. Co., Boston.............	10 00	
"	10—Elizabeth E. L. Co., H. W. Pope...	20 00	
"	10—Bishop Gutta Percha Co.............	10 00	
"	10—Callender Ins. & W. P. Co............	10 00	
"	10—Clark B. Hotchkiss....................	10 00	
"	10—Patterson E. L. Co......................	10 00	
"	10—Brush E. Co., Cleveland.............	10 00	
"	10—Dr. Otto Moses..........................	10 00	
"	10—Armington & Sims......................	10 00	
"	10—Jenny Electric Co., Indianapolis...	10 00	
"	10—Straight Line Eng. Co................	20 00	
"	10—Merchants' E. L. & P. Co., Boston.	10 00	
"	10—E. & E. Engineer, New York.......	10 00	
"	10—Okonite Co., New York................	20 00	
"	10—Daft E. L. Co., New York............	20 00	
"	10—The Northern E. L. Co., Phila......	20 00	
"	10—United States E. L. Co., Wash......	20 00	
			$240 00
			$1,398 38

Expenditures as Per Vouchers.

1885.			
Aug.	8—Postage....................................	$ 1 00	
Sept.	2—200 Copies *Scientific American*......	14 50	
"	3—Expressage..................................	35	
"	5—1,000 Copies *Electrical Review*......	78 00	
"	8—Expressage—*Stenographic Report*...	20	
"	8—Postage..	5 00	
"	8—Rubber Stamp...............................	1 35	
Oct.	3—Stamps	2 20	
"	10—E. Ryan—*Stenographic Report*......	78 00	
1886.			
Jan.	18—Postage	5 00	
Feb.	2—Telegram concerning Stenographer.	39	
"	2—Clerk's Salary from August 23 to October 31 inclusive, 10 weeks, at $20..	200 00	
"	6—Clerk's Salary from October 31 to February 6, 14 weeks, at $10....	140 00	
"	8—Printing admission cards, G. C. [illegible]................................	2 25	
	[illegible]ec. Committee.........	2 00	
	[illegible]ice........................	75	
	[illegible] Co., printing......	3 75	
	[illegible] Weil, postals......	2 75	
			$537 49

SUMMARY.

Cash Dr.—To Sundries.	$1,398 38
Cr.—By "	537 49
Balance February 12.	$860 89

Repectfully submitted,

H. E. REINHARD, *Secretary.*

THE PRESIDENT: After the report of the Treasurer, Dr. Moses will read the report of the Committee on "Electricity as an Illuminant."

MR. COOPER: The Treasurer will simply report that the amount of cash on hand is $862.48. He has vouchers for all payments.

DR. MOSES: In the absence of the Chairman of the Committee, I take pleasure in reading the report for him.

In the following brief review, your Committee on "Electricity as an Illuminant" have thought it advisable to treat of the advance in electric lighting as having been marked by periods of activity. The present uniform development indicates the near approach of another period in the history of this new and great industry, when electric light will occupy the position now held by gas as an illuminant. The subject is one that engages universal public attention, owing to the extent and wide distribution of gas interests, and because of the possible effect the growth of electric lighting may have on the value of petroleum and natural gas *in situ* as one of the future sources from which most illumination will be derived for use in the populous parts of this country.

In the conflict between electricity and gas as an illuminant, there is no point of advantage in favor of gas, except its cheapness. But this advantage will every day diminish, while the superior healthfulness of electric light, and its greater safety against fire, and the ease with which it lends itself to decoration, must force its acceptance by the public long before the equality of cost is reached.

We have divided a short history of electric light into five periods, which we will call by the following titles:

1. The period of Davy.
2. The period of Starr and Staite.
3. The period of the Alliance machine.
4. The period of the Paris Exposition.
5. The coming period.

Each one of the first four epochs has been marked by some great and essential development in which electric lighting approached much nearer to perfection.

The Period of Davy.—In 1813 Sir Humphrey Davy was engaged in establishing his fame in a series of brilliant lectures at the Royal Institution. He had decomposed the alkalies, and had produced sodium and potassium in their metallic state by means of the powerful current from a battery of 2,000 zinc-copper elements. With these cells he was the first to make the electric light.

In his classical experiments he produced:

1. The arc light in air, and in the vacuum of an air-pump.
2. The incandescent light in air, and in the vacuum of an air-pump.
3. For these purposes he made use of small pencils and rods of carbon from vegetable fibre, and in the dense form of the diamond.
4. He discovered that a point of rarefaction in different gases could be reached where the arc would not pass.

Schemes of electric lighting as early as this may naturally have floated in the heads of visionary inventors; but if they ever experimented in this direction the rapid polarization of Sir Humphrey's primitive batteries, and the difficulty of keeping an air-pump tight, would soon have dispelled their hopes. Gas, too, had just been introduced into London with great *éclat;* for we read of the vast illuminations made with it in honor of the crowned heads who visited that city after the fall of Napoleon I., and so electric light was laid aside.

From 1813, when Davy experimented with the electric light, until 1841, when Archereau and Delieul used it to illuminate the Place de la Concorde, in Paris, nothing seems to have been done to develop the necessary machinery for its automatic working, those gentlemen being compelled to push the carbons by hand as they were consumed.

In the meantime Grove (1832) had invented his depolarizing battery, and Bunsen had modified it by substituting carbon for platinum; and, incidentally, the latter had learned to make artificial carbon better adapted than wood charcoal for arc lights.

So bright a light as that produced by Delieul with 100 Bunsen cells, and one so well adapted for fine effects, could not fail to attract inventors. In the same year another departure in electric lighting, incandescence of platinum and charcoal or plumbago in vacuo, was made by an Englishman named F. de Moleyns.

The Period of Starr and Staite.—It was not, however, until 1845 that any serious attempt was made to introduce small electric lamps into public use, when J. W. Starr, a native of Cincinnati, went to England with an incandescent electric lamp,

having a carbon made to give light while in a Torricellian vacuum and over mercury. Here, with the assistance of Mr. George Peabody, the banker, he introduced it, but soon after died.

The next year a very ingenious Englishman named Staite took up the subject of electric lighting in all departments, and in a short space of time produced excellent arc lamps embodying many principles now, or recently, in use. He also patented an incandescent lamp, in which the illuminating organ made use of was iridium, as superior to platinum. He also much perfected the carbon used in arc lighting.

The great difficulty in his way was the want of a cheap source of electricity, batteries being found too expensive. This defect prevented his success.

Here the matter seemed to rest (if we except Archereau's application of the solenoid to arc lamps in 1848) until the invention of the dynamo machine furnished the missing link to the chain which had to be wrought before electric light could be commercially produced.

It is perhaps well here to note that it is claimed by M. de Changy that he and M. Jobard, of Brussels, in 1855 had made, but not operated, incandescent lamps identical in form with lamps now in general use; but his claims are not substantiated.

It may also be mentioned that simultaneously with the invention of the dynamo electric machine a patent was taken out in England (by one Shepard) for a Belgian inventor named Nollet—presumably the same person as he who conceived the dynamo (now in operation)—called after the company who manufactured it, the Alliance machine, and which remarkable machine, when constructed and improved by Van Malderen, first rendered electric lighting feasible.

The perfect germs of this engine were, however, found buried in the small magneto electric instruments of Pixii, Clarke and Page, which had been constructed almost immediately after Faraday announced his grand discovery of magneto electric induction.

It is also necessary to recall that Elias and Stohrer, in 1844, King, in 1846, Dujardin, in 1847, Henley, in 1849, had already done a great deal to render the dynamo possible.

The Period of the Alliance Machine.—The Alliance machine was originally intended to be used as a source of light by employing, for that purpose, the gases of water decomposed by its continuous currents. This fallacy was soon abandoned, and the machine converted into an alternating current one to be applied to electric lighting. It was set at work in a light-house at Havre, where it is to-day (as one of your committee has seen) doing very good work, never having been out of order from the day it started, in 1863.

A host of able inventors then began to develop the dynamo machine. Among these we would call especial attention to one who was far in advance of his time, and the anticipator of many recent inventions, Hjorth, of Denmark, who, in 1854-55, took out excellent patents in which the principle of augmenting electric currents by the reaction of electro-magnets upon each other was clearly described, as also the principle of exciting the field magnets by means of permanent ones.

Werner Siemens, of Berlin, constructed his armature in 1856.

Prof. Holmes, of England, made a machine which, when approved by Faraday, was used by the British government in an important light-house in 1856.

In 1858 an unknown inventor (represented by J. H. Johnson, of London,) first suggested the auto exciting principle, which afterwards was independently discovered and presented to the Royal Society by W. Siemens and Wheatstone.

In 1860 a new departure was made in the history of electric lighting by Antonio Paccinotti, of Italy, who constructed continuous current dynamo machines, which he also used as motors. In these most remarkable machines all the principles now employed are found. But it is worthy of notice, although attention has never yet been called to the fact, that the auto exciting capacity of the field magnets above referred to escaped the inventor's observation, and also the action and reaction principle, first observed, we believe, by Fontaine on accidentally coupling two Gramme machines together.

Wilde (1863), Varley (1866), Wheatstone and Siemens (1867), constructed machines containing the principles of the inventions just referred to, but which were independently discovered by them.

Prof. Rowland, of Baltimore, also, about this time, (or even before), had devised apparatus containing leading principles.

As your committee only propose to indicate the chief periods of development in the dynamo in its relation to electric light, we must here call especial attention to the machine invented by Z. T. Gramme, of Paris, in 1867. Although this machine was entirely an original invention, it varied little from that first described by Paccinotti in *Il Nuovo Cimento* in 1863; still its simplicity and efficacy caused an entire revolution in the production of electric light.

In the time which elapsed from the date of its invention to the Paris Exposition (1881) electric lighting became a business, but only by means of the arc light.

However, the possession of so convenient a source of electric power as the dynamo gave a great stimulus to inventors, and several again took up the subject of incandescent lighting. This new enterprise began in Russia, and in the course of a short time

Messrs. Lodyguine, Ronn, and Bouleguine, of St. Petersburg, constructed and put in operation, commercially, incandescent lamps with thin carbons, *in racuo,* contained in glass globes cemented in various ways. Experiments had also been made with Geissler tubes by Messrs. Benoit, who employed them as a source of light for miners' lamps.

It is necessary here to recollect that the invention of the Geissler and the Sprengel mercury pumps, the elaborate and classic studies of Pflücker, Crookes, Gassiot, De la Rive, and others, and the perfection attained by Carré, Gaudoin, etc., in the manufacture of electric light carbons, had paved the way for the successful invention of incandescent and semi-incandescent lamps, and thus enabled Werderman, Jablochkoff, Swan, Edison, and many other inventors, to engage in their manufacture and perfection, so that at the Paris Exposition, in 1881, it was possible to show lamps that have not undergone much change in form since that day—so much so that capitalists became convinced that electric lighting had reached a point where they could invest in its development.

The Paris Exposition.—This period is memorable for the wonderful impetus given to electric lighting, and for the opportunity it afforded to investigate the claims and merits of rival inventors, by a comparison of the extensive collections of historic apparatus exhibited. Other expositions exclusively devoted to electric subjects were held in London, Vienna, Munich, Philadelphia, and other places, and through their united influence electric lighting has impressed itself upon the business of the age.

The Coming Period.—Much has yet to be done by discovery, invention and development before electric lighting will occupy the commanding position it will inevitably assume. In conclusion of this report, your committee would call attention to the new fields which are to be explored, and to the directions in which what we have is to be developed and perfected.

Central Stations.—The distribution of electric power from central points is going to be the future source of energy for light and other purposes in cities. These points will be in the coal, petroleum and gas districts, and in the neighborhood of large water powers. The power which will reach the cities will be stored at central stations or be transformed there for general distribution. Enormously expensive and cumbersome systems of distribution will be abandoned, and currents of high potential must be safely transformed into currents of low potential at the door of the consumer, or, if not needed, be stored for future use. At present, central stations employ their capital fruitfully only about six hours in twenty-four. This must be avoided by using the plant, when light is not wanted, in storing and distributing currents of different potentials to local transforming centers of

consumption by means of more than one system of radial conductors.

Transformation Direct of Fuel into Electric Light.—The greatest problem that can now occupy the mind of the electrician is the generation of electricity directly by decomposition of the hydro-carbons, etc., without the intervention of the dynamo. The solution of this problem will simplify the production at the coal fields, etc., and the discovery will reward the one who makes it with untold wealth and honor.

There is an immense field for activity in perfecting and applying thermo-piles, accumulators, potential transformers, Geissler tubes, incandescent lamps, arc lamps, semi-incandescent lamps, meters, gas engines, etc., to electric light purposes.

The engineer who applies himself to these subjects has a mine of wealth before him Let him remember that electric lighting, as a business, did not exist ten years ago, and let him also recollect that the gas lighting is the largest manufacturing industry in the world, and that electric light will be welcomed in every place wherever gas has poisoned and blinded with its fume and flicker.

MR. RALPH W. POPE: I would like to inquire of Dr. Moses in regard to the construction of the Paccinotti machine. I believe it was constructed originally as a motor, and the qualities of generating the current were discovered by accident. If he has the information, I will be pleased to hear it.

DR. MOSES: It was a very interesting subject at the time of the Paris Exposition, when Dr. Paccinotti, who was an entirely unknown person, came there and exhibited three of his models. They were in the Italian exhibit. They were not constructed in a workshop. They were made by him, probably, by his own hand; and they indicated a thorough comprehension of all the principles, except the one I have spoken of. He had investigated first, as Mr. Pope says, the question of motors. He was repeating the experiments of Jacobi on motors, but before he finished his machine the idea flashed through his mind that he would make it a generator, and the machine showed that he had that intention. The subsequent form of his machines embodied principles so similar to the most extensively used machines to-day, that it is very difficult to distinguish them apart.

MR. CLEVELAND: We shall all be very glad, no doubt, to hold two sessions to-day, and it will be for the Convention to say whether we adjourn until four o'clock, or until half-past seven this evening. I move, sir, that we adjourn now, to meet at half-past seven this evening.

The motion was seconded.

MR. KING: I move, as an amendment, that we adjourn to 4 o'clock.

The motion to adjourn to 4 o'clock was carried.

AFTERNOON SESSION.

The Convention was called to order at 4 P.M.

THE PRESIDENT: The Secretary will now call the roll. Each company is entitled to three representatives on the floor of the Convention.

The Secretary then called the roll, and the following gentlemen answered to the names of companies entitled to active membership:

Kansas City Electric Lighting Company, of Kansas City.—E. R. WEEKS.

Minnesota Brush Electric Light Company, of Minneapolis, Minn.—T. S. KING.

Allegheny County Light Company, of Pittsburg, Pa.—S. A. DUNCAN and S. A. GRAHAM.

Bridgeport Electric Light Company, Bridgeport, Conn.—H. G. STANLEY.

Brush Electric Light Company, Philadelphia, Pa.—A. J. DE CAMP.

New Haven Electric Light Company, New Haven, Conn.—F. A. GILBERT.

Newport Illuminating Company, Newport, R. I.—JAMES ENGLISH.

McKeesport Electric Light Company, McKeesport, Pa.—C. BAGSHAW.

Taunton Electric Light Company, Taunton, Mass.—D. L. MITCHELL.

Jamestown Electric Light Company, Jamestown, N. Y.—T. H. Smith.

Commercial Electric Light and Power Company, Boston, Mass.—Allan V. Garratt.

New Bedford Electric Light Company, New Bedford, Mass.—Samuel C. Hart.

Waterhouse Electric Manufacturing Company, Hartford, Conn.—H. M. Cleveland.

United States Illuminating Company, New York.—E. T. Lynch.

Schuyler Electric Light Company, Hartford, Conn.—H. M. Linnell.

Elizabeth Electric Light Company, Elizabeth, N. J.—Henry W. Pope.

Riverside and Oswego Company, Providence, R. I.—R. T. Robinson.

The associate members answering to the names of their companies were as follows:

Pittsburg Carbon Company, Pittsburg, Pa.—E. B. Dickey.

H. C. Adams, *Agent,* Holmes, Booth & Haydens, New York.

Jarvis Engineering Company, Boston, Mass.—J. F. Upton, H. G. Pratt.

Ansonia Brass and Copper Company, New York.—F. G. Stone.

Callender Insulating Company, Newark, N. J.—W. M. Callender.

Westinghouse, Church, Kerr & Co., New York.—Walter C. Kerr.

American Electric Manufacturing Company of New York.—George L. Beetle.

Armington & Sims Engineering Company, Providence, R. I.—Gardiner C. Sims.

Clark D. Hotchkiss.

Morris & White, Boston, Mass.—D. Morris.

Ralph W. Pope, New York.

Onega Manufacturing Company, New London, Conn.—A. S. Hickley.

Southern Electric Company, of Baltimore, Md.—D. H. Tuxworth.

Electrical World, New York.—T. C. MARTIN, C. E. STUMP.

ARTHUR STEWART, Baltimore, Md.

The Secretary read telegrams from G. S. Bowen, St. Louis; the Fort Wayne Jenney Electric Light Company, and L. A. Sperry.

A GENTLEMAN: I wired Mr. Bowen a day since to enter the Jenney Electric Company, of Minneapolis, as a member. He seems not to have done so. I don't know what action should be taken.

THE PRESIDENT: A paper by Mr. John W. Beane on "The History of the Progress of Electric Lighting" will now be read:

MR. JOHN W. BEANE: *Mr. President and Gentlemen*—In view of the rapid growth of electric lighting, and its widespread and varied applications at the present time, an adequate treatment of the interesting subject of this paper within a limit proper to the occasion is not only difficult, but well nigh impossible.

The progress made in the field of commercial electric lighting has been remarkable—indeed, it has been wonderful. When it is considered that but ten years ago the electric light had just reached the dawn of its commercial career, whilst to-day there is not a civilized country on the face of the globe that does not feel the glory of its rays—that from functioning as a mere scientific curiosity, it has at length become a most important and beneficent factor in so many of the operations of daily life—we cannot but wonder at the magnitude of the work performed, and render praise, so well earned, so justly due, to the instruments of its accomplishments.

Whilst we must go back as far as the year 1802 for the first exhibition of the electric arc between poles of carbon, to Sir Humphrey Davy is due the honor of the discovery. Not until 1836 was any substantial headway made towards the solution of the problem of practical electric lighting. Then fresh impetus was given the subject by the advent of the Grove voltaic battery, and for the first time the production of the electric light on a practical scale became possible. In the same year it was installed for theatrical purposes at the Opera House in Paris.

The many superior qualities of the electric light were early appreciated, yet its employment was limited, principally owing to its high cost and the crude methods of its production. Among the noteworthy cases of its early use, it may be interesting to recall the installation at the building of the Cherbourg Docks, in

1858, whereby work was continued at night, as well as during the day-time, where 1,800 men were constantly employed. Notwithstanding the fact that Faraday discovered the principles of electro-magnetic induction as early as 1831, thirteen years elapsed before a machine for electric lighting on a large scale was produced. Stohrer, of Leipsic, was its constructor. Nor was it until about the year 1862 that the first successful permanent plants were installed, they being used in light-houses on the French coast. The most romantic portion of its early career, perhaps, was its service during the siege of Paris, in 1870 and 1871, when the French employed it for watching the movements of the enemy.

The year 1879 seems a natural dividing line between the early and recent history of electric lighting. Prior to this year Pixii had made the first application of Faraday's discovery; Siemens had invented his well-known form of armature; the principle of mutual accumulation had been discovered and applied; Paccinotti had exhibited his ring armature; Gramme had brought out his perfected form of the same idea; Nollet had constructed the "Alliance" machine; and in America, Wallace-Farmer had their machines on the market, and Brush had obtained a foothold with his system of arc-lighting. At the close of 1879, Sawyer, Man, and Edison had perfected their incandescent carbon lamps. In Europe, Paris led the way, and at the close of 1878 some 300 arc lights were in use in the boulevards, gardens and public buildings of that city. The Jablochkoff candle then held full sway, and it was shortly adopted to light the Thames embankment in London. At the beginning of the year 1880 we find a few light-houses on the French and English coasts, and a small portion of the streets of New York, Philadelphia, London and Paris lighted by electricity. The infant, however, was of sufficient size to suggest the giant it has since become. Opposition began to rear its head, and from that day to this its struggle for recognition has been as severe as phenomenal.

It is interesting to look back upon the vast multitude of dynamo and magneto-electric machines which have been evolved during the past fifteen years, and note that to-day the number of types in actual use for lighting can almost be counted upon one's fingers.

The great advance has been made in the direction of the perfecting of details; and whilst, in 1880, there was hardly a generator that did not waste a considerable percentage of energy in the heating of its armature, useless friction and pyrotechnical exhibitions of an extraordinary character at its brushes—a commercial efficiency of 84 per cent. being considered phenomenal—to-day we have machines that run continuously for months with no other attention than their lubrication and the replacement of

brushes—no sparking, no heating—and in which an efficiency of over 88 per cent. is easily attained. In the Paris system of 1878 alternating current machines were used with small continuous current magnetos to excite the field magnets. A sixteen-lighter was the largest machine employed, whereas to-day the forty-five-lighter is the average machine, sixty-five-lighters being quite extensively used.

What has already been said of the prolific invention of electric generators applies with double force to the case of electric lamps. There has been, we may say, a perfect "downpour" of this character of invention. In fact, it would seem as if every inventive genius since the time of Dubosq had, at one time or another, tried his hand at the conception of a new arc regulator. The field has, at length, so narrowed down that we find lamps in almost universal use, operated on the clutch principle, and regulated by means of an electro-magnet placed in a shunt spanning the arc. Next to the lamp, in importance, comes the carbon. In no small measure is the successful application of the voltaic arc to practical lighting due to Foucault's suggestion of the use of pencils of gas retort carbon. This improvement has been followed by others, so that at the present time the manufacture of carbons has reached a high state of chemical and mechanical accuracy. Instead of gas-retort carbon, a somewhat similar but purer form of carbon, combined with other materials, is now most largely employed. The light from a given current has been more than doubled by the improvements in the character of the pencils used since gas-retort carbon was first introduced.

The early history of the incandescent lamps dates back to 1838, when Professor Tobard, of Brussels, proposed the commercial application of the fact that a carbon filament *in vacuo,* under the action of a passing current of electricity, became incandescent, emitting an intense fixed light; but its commercial career began in the latter part of 1879, when Edison patented his glow-lamp. From that day to this its general form has not been much changed; but, in point of efficiency and life, remarkable improvement has been made. At the Paris Exhibition of 1881 the best average number of standard candles per electrical horse-power obtainable was 196, and four hundred hours was considered a good average life. Recent tests show 210 candles per horse-power, and the average life nine hundred hours. We are, therefore, able to obtain about a lamp more from a horse-power, and have doubled the life. These improvements are due quite as much to a better knowledge of their care and manipulation as to better modes of manufacture. In point of cost, lamps that cost $5 at the time of the Paris Exhibition of 1881 can now be bought for less than $1.

Intimately connected with the expense and care of any system of electric lighting is the power; and, when we realize that only one-fiftieth of the energy of the coal used to develop that power is obtained as light and heat in the filament of the incandescent lamp, and the electrical losses, such as the resistance of mains, losses in the dynamos, etc.—insignificant as compared with those of the steam engine and boiler—the importance of improvement in this direction is manifest. At the outset electric lighting called for a new class of engines suitable to be used with dynamos, and the able manner in which this want has been supplied may be gathered from a study of the many high-speed engines of the present day, especially those of American make—improvements in self-regulation, a greater simplicity of parts and a capacity for long-sustained operation being among their many excellent qualities. In this connection it may be mentioned that a steam motor, acting on the turbine principle, has been running without a single stoppage for six months past at the London Inventions' Exhibition, driving a dynamo at 12,000 revolutions per minute, and lighting thirty-two 50-candle power incandescent lamps. Several of these have already been installed in steamships and mills in England. It is probably unnecessary to state the advantage gained, from a commercial point of view, by this high speed.

Since the early days of electric lighting, the play-house has proved its steadfast patron, and the Paris Opera House may very appropriately be called its godmother. The progress made in this branch of lighting has been very satisfactory. It is rapidly growing in the number of plants installed; and it is not too much to say that the outlook for its exclusive adoption for theatrical lighting is extremely bright. There are now many fine installations of this character at home and abroad, among the most noteworthy of which are the Opera House in Paris; the Prince's Theatre, the Savoy, and the Criterion, in London; the Prince's Theatre, in Manchester; the Prince of Wales and Royal Theatres, in Birmingham; two theatres in Glasgow; the Court and Palace Theatres, in Munich; the Court Theatre and Town Theatre at Brunn; and a number in Berlin, Vienna, Stuttgart, and other large cities on the Continent. The largest installation in the world is that at the Theatre Della Scalla, in Milan, which is lighted by 2,862 glow lamps. In this country there are in all some thirty theatres lighted entirely, or in part, by electricity; as, for instance, McVicker's Theatre, and the Chicago Opera House, in Chicago; the Milwaukee Opera House; the Metropolitan Opera House, where it is used for stage effect, the Third Avenue Theatre, Lyceum Theatre, and Miner's Theatre, in New York, and others of less note in different parts of the country. McVicker's has, probably, the largest plant of the kind, lighting

1,200 incandescent lamps in all; whilst for artistic design and novel effect, the installation of the Third Avenue Theatre ranks second to none.

The incandescent system has, to a large extent, monopolized this field, owing, among other things, to its ease of manipulation. A plant has recently been installed in Paris where the arc lamp is used in connection with a certain novel arrangement for increasing or decreasing the amount of light allowed to escape from the lantern in which it is placed.

It is hardly within the province of this subject to detail the advantages gained by the use of electricity for theatrical lighting; indeed, it is not necessary; they are too obvious. Suffice it to say, that there is every reason for its adoption, not only in point of safety, health and comfort, but also for economy's sake, since, in installations of, say 200 lights and over, its cost is now less than that of gas.

The advance made in central-station lighting is worthy of especial note; for in this we have a reliable indication of the popularity to which lighting by electricity has attained. All of the principal cities in the United States have, one after another, adopted central-station lighting and ours stands to-day the most brilliantly lighted country in the world.

New York city, first in the field, maintains the lead, and there are not less than 5,000 arc lamps in operation nightly in her streets, buildings and public places. Boston and Chicago follow with about 2,000 less; whilst Philadelphia lights upwards of 2,000. Central-station lighting by the incandescent system has grown very rapidly since 1882, when it was introduced; and at the present time there are over 50 towns and cities lighted, in part, or entirely, in this way, burning more than 100,000 lamps daily. Tower-lighting has scored some success in the West, and boasts a number of towns and cities where it is exclusively used—as, for instance, Detroit, Peoria, Elgin, San Jose, Los Angeles, Pekin, and Decatur.

Abroad we find quite a number of examples of central-station lighting, although there are none that reach the capacity of our own large plants. Among the more important ones may be mentioned the Holborn Viaduct, Brixton, Victoria Station, Godalming, Chesterfield, Colchester, Greenock, Glasgow, and Edgeware Road Station of the Metropolitan Railway, in Great Britain; St. Etienne, Tours, Haute-Savoie, and Roche-Sur-Foron, in France; and in Prussia, Austria, Hanover, and Germany—a portion of the streets being lighted by glow lamps. The only town in Europe lighted entirely by electric light is Temesvar, Austria. Paris lights the Jardin de Paris and the Champs Elysees.

Central-station lighting is growing in Europe; and, whilst not in the same proportion as in this country, it is a good, healthy increase—conservative, sure, and indicative of the firm hold the light now has upon popular favor in that part of the world.

Isolated lighting in the field of arc lighting amounts in this country to only about one-fourth of the entire number of lamps installed, whereas in Europe isolated lighting is the rule rather than the exception both in arc and incandescent lighting. In this country there are nearly twice as many lamps installed in isolated plants as in central-station systems. The reason for this is owing to the fact that about sixty per cent. of the lamps operated are installed in manufactories, mills, refineries, and miscellaneous manufacturing establishments, where the facilities for the use of local power are great. It would be an almost endless task to mention even a tithe of the vast multitude of private or isolated installations which notably abound in this country, there being some 23,000 arc and 165,000 incandescent lamps in operation daily.

The greatest increase is to be found in installations for banks, office buildings, and stores, whilst the number of plants now finding place in hotels, newspaper and printing offices is noteworthy, there being not less than fifty newspaper and printing offices so lighted throughout the country. Among the number we find the offices of the New York *Herald*, the *World*, *Tribune*, *Sun*, Boston *Herald*, and Detroit *Free Press*.

The Palmer House, in Chicago, Murray Hill Hotel, Hotel Dam, the Union Square Hotel, and Gilsey House, in New York, are, perhaps, the best-known hotel plants; although there are quite 20,000 lamps, arc and incandescent, employed to light the hotels, club-rooms, etc., in this country.

In Europe, the number of isolated plants is rapidly growing from day to day, and several of the famous American electric light companies have done much to push the good work along. The London Stock Exchange, the *Irish Times*, *Daily Telegraph*, and London *Times* buildings, are lighted by electricity; also, the new London Law Courts, the House of Commons, and the Colonial Parliament Houses in Cape Town and New South Wales; the Municipal Hospital in Havre, the Female Hospital in Berlin, the Bauer Cafe in Frankfort-on-the-Main, the University of Paris, the Hippodrome, the Magasin du Louvre, the Magasin du Gagne-Petit, the Hotel Continental, the Opera, the Eden Theatre, the Grand Hotel, the Magasin du Printemps, the Cafe de la Paix, the Lycee Louis le Grand, in Paris; the railway station at San Pierdarena, Italy; the Central Railway station at Budapest, Hungary. In Munich there are about 4,000 incandescent and 200 arc lights. Isolated plants are established in

Berlin, Hamburg, Dresden, Hanover, Bremen, Cologne, Leipsic, Breslau, Chemnitz, Crefeld, Barmen, Elberfeld, and a large number of smaller German towns. In all, there are not less than 2,000 arc and 25,000 incandescent lamps installed throughout Germany, exclusive of those in isolated establishments, not connected with gas systems. We may state that this estimate falls far short of the entire number. We also find isolated plants of incandescent lamps in many smaller towns in England, as Norwich, Plymouth, Nottingham, Harrogate, Edinburgh, New-Cross; and in France, as Armentieres, Tourcoing. In Italy, Turin and Palermo are partly lighted by electricity; Ghent, in Belgium, and Barcelona, in Spain.

Domestic lighting, that is the lighting of private residences, has not flourished here in the same proportion as lighting for business purposes, owing to a disinclination to assume the increased expense. There are many more installations for private lighting abroad than in this country; among the more prominent examples of which are the residence of Mr. Preece, (probably as perfect in its detail and interesting as any plant of this character); the Castle of the Marquis of Bute, which is lighted by 400 glow lamps; the residence of Mr. Walter Laing, near Harwick, in England, lighting 100 incandescent lamps; the Chateau de Ferrieres, belonging to Baron Alphonse de Rothschild; the Palace of Prince Manko-Negoro, of Java; C. P. Huntington's mansion, at Astely Bank, England; the residence of Mr. Phipps, in London, etc. It may be mentioned, in this connection, that a number of art and picture galleries and libraries have been lighted by the electric light; among which are the Boston Art Club, Columbia College Library, the Central Hall and Corporation Galleries, of Glasgow, the Brighton Art Exhibition, and others.

The accumulator plays its part in many of these private installations. Its use is extending rapidly, owing to marked improvements during the past year or so in the general efficiency, due probably to our more extended experience in its care and management. It is used economically in large plants at Cheyenne, in this country, and in Colchester, England. Lighting by the primary battery has not, so far, made very great headway, owing to its two great drawbacks—polarization and expense.

The lighting of railway carriages by electricity has been a matter of experiment in England for two years past, and has proved a perfect success, it having been found cheaper and more effective than any other method of illumination. The first notable instance of this kind of lighting was on the coaches of the London and Brighton Railway, where two trains are now constantly running with plants consisting of accumulators, which are charged by a dynamo connected with the axle of the guard's van.

Experiments have also been conducted, and trains are now running lighted in this way, on the London and Northwestern, South London, the Great Northern, Lancashire and Yorkshire, and Great Eastern Railways, in England, and the Frankfort, Fulda and Ulm Line, in Germany.

Our own Pennsylvania Railroad now runs an experimental train between Altoona and Pittsburg, using accumulators. The light is said to be very satisfactory.

The great value of a powerful light, such as the electric light for railway purposes, was early recognized, experiments being begun about 1875 to adapt it for use in headlights for locomotives. It is one thing to arrange an ordinary arc lamp regulator with a single feed, and another to perfect a lamp with a double feed, so that the arc shall remain constantly in focus, notwithstanding the excessive jarring to which it is necessarily subjected when used for this purpose. Although this has proved a formidable obstacle to a solution of the problem, it has been successfully overcome; and in this particular there are arc lamps on the market to-day that are all that could be desired.

There has been considerable progress made in this field during the past few years, notwithstanding the absurd objection to their general adoption, that they cause an obscuration of the colored signal lights. If this were, in any measure, true, it is a difficulty that can be easily overcome. The advantages of a light which will illuminate a track as light as day for a distance of over a half mile, so that an express train traveling at night at top speed can be stopped in time to avert disaster, which, in many cases, with our present mode of lighting, would be impossible, is one not lightly to be thrown aside; and the time is not far distant when public opinion will force our railways to its adoption.

This light is in use in Russia. In this country it is installed on several roads running into Cincinnati and Indianapolis. It is being used experimentally on suburban trains of the Illinois Central, at Chicago, and also on the Lehigh Valley Railroad.

Perhaps in no place has the electric light proved more welcome than on board ship, and here its superior qualities appear all the more striking. The stowing of inflammable oils is avoided; the air of the saloons and cabins is greatly improved, in point of purity and temperature; and, above all, the danger of fire at sea is lessened to a great degree. The first recorded instance of ship-lighting was that of the steamship *Columbia*, of the Oregon Steam Navigation Company, in December, 1879, in which sixty lights were installed.

Since then this branch of lighting has grown slowly, with very bright prospects for the future. To-day there are in this country many fine ship plants in operation on our bays and sounds of the East, and lakes and rivers of the West. Especially interesting

are those of the palatial Sound steamers, plying on the Boston routes through Long Island Sound, their saloons, state-rooms, steerages, holds, engine-rooms, etc., being lighted by a total of from 400 to 500 incandescent lamps. Quite a number of our men-of-war are now illuminated in this way; and the plans for all the new ones in course of construction call for electric light installations. Of the steamships plying between American and European ports, thirty-three are supplied with electric light plants. In England more attention has been paid to this matter than in this country; and although it has been only three years since the first application of incandescent electric lighting to the general illumination of steamships, yet more than one hundred and seventy-five ships have been lighted in this way; and now scarcely a man-of-war or a first-class passenger steamer leaves the builders' hands that is not fitted with the electric light.

It is used on board of steamers of the Peninsular and Oriental Steam Navigation Company. Thirty-two steamers on the Seine are lighted by the incandescent system. Such powers as France, England, Germany, Italy and Austria have adopted it for the illumination of their war and other ships; so with Chili and Brazil. Many of the ships fitted with electric light plants also carry powerful arc search-lights (about 15,000 C. P.) for look-out purposes.

Quite a number of yachts have added the luxury of an incandescent plant.

The electric light has been in use in light-houses since 1863, when it was first installed at the French First Order Light-house of La Héve, near Havre; and one and a-half years later it was applied at the other light-houses of La Héve, the "Alliance" magneto-electric machine and Serrin lamp being used. The light has been since adopted for several other light-houses in France; at the South Foreland and Cape Lizard, in England; Odessa, in Russia; Port Said, in Egypt; on the Island of Raza; in the Bay of Rio Janeiro; at Hell Gate, Long Island; Long Island Sound, and a few other places.

Although the great value of the electric light for coast lighting purposes was so early recognized, yet its advance has not been rapid in this field. Recently, however, active interest in the subject has revived with the improvements in the means of producing the light and our more extended experience in its management; and for some time past exhaustive experiments have been in progress at the South Foreland light-houses to determine its status as compared with oil and gas for light-house purposes. The committee appointed by the Corporation of the Trinity House, which conducted these experiments, reached the conclusion and reported that "for the ordinary necessities of light-house illumination, oil is the most suitable and economical

illuminant; but for salient headlands, important landfalls, and places where a very powerful light is required, electricity offers the greatest advantages."

In this country experiments are being conducted by our government at the Experimental Light-house Station at Tompkinsville, Staten Island, with very satisfactory results. The incandescent lamp of high candle power possesses certain qualities which promise to render it of use as a light-house illuminant, and considerable experimental work is being done in this direction.

Mine lighting by electricity has been an accomplished fact for some years past, and we now find it installed in mines of all characters. At the Fresuais Quarry, at Angers, France, we have probably the first instance of mine lighting by the electric light, the plant having been installed in August, 1878. Since then several mines in this country have adopted it. A number of the English collieries are lighted in this way. At many of the French, German, and Belgian mines it is used on the surface and at the landing stages at the head and foot of shafts. At the celebrated Mechermich mines in Prussia it has been on trial for the past four years with very gratifying results. The mines of Terpentery are lighted exclusively by electricity. It is employed at tne Weissbach mines, at Hausham, and at Peuzberg—all in Upper Bavaria. Its use is extending in this direction, and very naturally so since it is so perfectly adapted to this character of work.

In the lighting of mills, factories, workshops, refineries, in short, establishments of a purely industrial character, we have at present the most flourishing branch of electric lighting. The first plants of any considerable size in this country were thus installed; and abroad, say in France and Germany, outside of the large cities, the use of the electric light is confined principally to the illumination of mills of all descriptions and manufacturing establishments.

The introduction of electric illumination into mills has been followed, in all instances, by most gratifying results, both in regard to the quality of fine figured or colored goods, and the health of the operatives. Where we are enabled to cast upon work of this kind a light of a quality capable of disclosing all shades of color, the character of the work must be surely improved. With gas this has been impossible. Heretofore colored goods manufactured in the winter were always found to be inferior to those produced in the summer, which fact was due to the use of artificial illumination by gas for a greater number of hours in the winter than in the summer. The electric light has changed this, and we now find the quality of goods invariable where this light is used. Indeed, so favorable have been the

results obtained that, in New England, mills not lighted by electricity are decidedly the exceptions, and it is safe to estimate at present at least 90,000 incandescent and 6,000 arc lamps in use in the United States for lighting mills, factories, and miscellaneous manufacturing establishments.

These, gentlemen, are perhaps the principal applications of the electric light to every-day use; but there are other special cases too numerous to mention. For instance, in Algiers, where the temperature is so high for the greater portion of the day that harvesting by Europeans is utterly impossible, the work is conveniently done at night by aid of the arc light. In the war between the English and the Mahdi, in Egypt, a portion of a railway was built by portable arc lamps. Work on the bridge across the Forth, in Scotland, is prosecuted at night by means of an arc light installation. Submarine boats have recently been lit by incandescent lamps, and so on, *ad infinitum.*

In the United States and Canada the electric light finds its widest applications. In the States there are upwards of 95,000 arc and nearly 250,000 incandescent lamps distributed in over 400 cities and towns.

Canada is a little behind this in proportion to her population. Guatemala has probably the largest installation of any city in South America, burning 300 arc lights. Valparaiso boasts 200 arc, and the City of Santiago 2,000 incandescent lamps. The cities of Mexico, Buenos Ayres and La Plata, are each lighted by the electric light. There is hardly a nation on the Western Continent that does not boast of the electric light within its boundaries. So with Europe, Asia, Australasia, and even Oceanica. In Australasia, according to a recent report, there are 400 arc and 5,000 incandescent lamps in daily operation. In Europe there is but one country in which the electric light may not truthfully be said to flourish, and that is in Portugal. The largest installation throughout the length and breadth of the kingdom consists of a dynamo and a solitary arc lamp, which is used at the ancient Tower of Belem, on the Tagus. In Germany, during the last six years, 6,000 dynamos and 20,000 arc lamps have been manufactured. In France the most popular light is the glow lamp, of which there is a large and daily-increasing number installed. Water-power is largely used in the interior for the generation of electricity. Austria, Belgium, Italy, Switzerland and Russia all possess installations of more or less importance.

England, whilst unfortunate in the possession of an unreasonable "Electric Lighting Act," passed in 1882, which in a great measure bars the application of capital to this enterprise, owing to the elements of uncertainty which it introduces, still has made very commendable progress; and as there is a probability

of the repeal or modification of this law in the near future, the prospects of much more extended operations in that country are very bright.

Experiments have been under way for some time past at the Suez Canal, and it is announced that, to accommodate the great increase in the traffic, it will shortly be lighted throughout its entire length by electricity, so that ships may pass at night as well as in the daytime.

China and Japan boast a number of plants; and as a proof of the enterprising tendency of the electric light, we may recall the fact that the palace of the Ameer of Afghanistan is lighted by electricity.

In the United States, however, the electric light has advanced with greater strides than in any other country in the world. Only 13 years ago Prof. Tyndall exhibited at Horticultural Hall, in Philadelphia, probably the first arc lamp seen in public in the United States. It was a poor specimen of the arc lamp as we now know it. At the present writing there are not less than $70,000,000 invested in the business of electric lighting in this country alone, and at least 25,000 incandescent and 12,000 arc lamps are newly installed each year. Over six tons of mercury and 700 air pumps are in use for the manufacture of glow lamps. In Paris, in 1878, the cost to the city was at the rate of 29 cents per hour for a lamp of from 500 to 700 candle power. To-day, under like general conditions, the city of New York pays at the rate of about 6 cents per hour for a lamp of 2,000 candle power. There are 300,000 carbons manufactured for arc lamps in the United States daily, one of our large firms consuming 25 tons of petroleum coke per week.

To those who have watched the progress of electric lighting, this bright survey of the present state of the art cannot but also recall the dark days of 1881, when, surrounded by distrust and suspicion, following a season of wild speculation, the outlook was gloomy indeed, especially so in Europe. Who but the most sanguine could then have predicted what we see to-day?

The future prospects of electric lighting are indeed flattering; and when we consider that, of all commercial enterprises, the capital invested in illumination is second only to that employed in transportation, the vast possibilities before us may be realized. Gentlemen, we have seen the budding, and will soon behold the flower.

The President: After recess a paper will be read by Mr. Martin on "The History and Progress of Electricity as Applied to Motors."

The members of this Association will consider that, while one set of gentlemen may be interested in only

one of the subjects here considered, they should be interested in all, from the fact that each bears directly or indirectly upon the one preceding or following it. They, therefore, render a service to this Association by attending all the sessions. In order to get the information to which they are entitled, it is necessary to be present at every meeting. I know it is hard work to sit through two sessions of a convention in one day, but this only occurs once in six months.

A recess of ten minutes was then taken.

After recess Mr. Duncan said:

Before proceeding in the regular order I desire to introduce a resolution. Before introducing it, I wish to state that, in conversation with some of the associate members they seem to be under the impression that they are not entitled to any privileges here. They seem to think that their privileges are somewhat abridged. Now, it strikes me that an interest in the Convention will be increased if they participate in the debate. They, therefore, should understand, once for all, that they are entitled to all the privileges of the floor, except the right to vote. I, therefore, propose the following resolution:

Resolved, That associate members are entitled to all the privileges of the floor, except the right to vote.

I move the adoption of the resolution.

Mr. Cooper: Is not that in our by-laws now, Mr. President? Wasn't it adopted at the last meeting?

The President: Article 3 was amended to read, with reference to associate members, that they "shall be entitled to the floor only with the consent of the Executive Committee or the presiding officer." Now, the adoption of this resolution gives the right without putting the question to the Convention. The fact of the case is that the associate members desire to feel that they have a right to the floor, and this is a sort of blanket resolution to cover the general consent.

The resolution was seconded by Mr. Cooper, and adopted.

Mr. De Camp: Does that necessitate a change in our by-laws?

The President: No, sir; it is a resolution covering the consent of the whole.

I have on the table a resolution offered by Mr. Henry W. Pope, which the Secretary will read.

The Secretary read the following resolution:

Resolved, That a committee be appointed by the Chair to tabulate rates for lights existing in the various companies represented in this Convention; and that said committee report at the next session of the Convention.

Mr. King: I would like to ask if that is intended to cover all rates, public and private.

Mr. Pope: Rates for public lighting alone.

Mr. Duncan: If the gentleman will insert the word *public* I will second the motion.

Mr. Pope: I will accept the amendment.

Mr. De Camp: I would like to make the suggestion that the same committee be instructed to gather statistics as to the total number of arc lights burning, whether private or public. I think that would be valuable information for us. Of course, the price would be very interesting, if it can be reliable.

Mr. Henry W. Pope: It was the intention when offering this resolution to get a report before this Convention adjourns. It is impossible to get the statistics that the gentleman requires in time. It can, however, be reported at some future meeting of the Convention, or be reported to the Secretary to be inserted in the minutes.

Mr De Camp: I see that point. I withdraw my motion.

The resolution was adopted, and the Chair appointed on the committee Mr. H. W. Pope, of New York; Mr. Duncan, of Pittsburg, and Mr. J. F. Noonan, of Paterson, N. J.

The following paper was then read by Mr. T. C. Martin, for Mr. W. J. Johnston, on the "History and Progress of Electricity as Applied to Motors:"

Mr. President: In compliance with your request for a report on the "History and Progress of Electricity as Applied to Motors," I beg to submit herewith for your consideration what must

naturally be regarded as but a brief outline of this important and growing application. Important as the subject now is, however, one would not hazard much in venturing the assertion that in the future it will, with but one or two exceptions, outstrip in magnitude all other developments of electricity.

Notwithstanding the attention we have paid to electric lighting, I and those associated with me in journalistic work have given much careful thought, and devoted considerable space to discussing and recording various applications of electricity to power. I presume that this is the reason why you have assigned the subject to me; and I am glad you have, for it gives me an opportunity of laying before the Association some suggestions and recommendations in regard thereto which I deem of especial value to electric lighting interests.

The designation, "Electricity as Applied to Motors," may upon analysis be made to include considerably more than is usually understood by that phrase, for it cannot be gainsaid that many applications of the motors, though in a disguised form, could be brought under the above heading. Thus, when we turn the crank of a magneto call on a telephone line, we set a motor in operation at the other end whose work consists in striking a bell and producing a sound. In the same way the telegraph sounder must be considered a motor, and it need hardly be said that many more of these examples could be cited. But I do not believe I will be taken to task if I pass over these forms and limit myself to motors in the restricted sense. I shall further take the liberty—in fact, the necessary limits of this paper compel me—to confine myself to the motor of to-day, which is the one that particularly occupies the attention of those engaged in electric lighting.

Though the electric motor existed long before the dynamo, it attained no prominence until after the discovery of the continuous current machine. There were two reasons for this In the first place, the galvanic battery constituted the source of power, and it is almost needless to say that so long as this condition obtained, the application was restricted. The second reason must be sought in the defective construction of the early motors themselves. These, with but few exceptions, were so made as to generate but comparatively weak counter-electromotive force, and hence the work which could be obtained from them was small in comparison with the power expended and their size. The advent of the continuous current dynamo, however, at once removed the dependency upon galvanic batteries; but, more than all, the discovery of its reversibility put the electro-motor upon a firm foundation and opened up for it a wide sphere of usefulness.

While Paccinotti and Siemens deserve credit for having perceived this valuable property, the discovery of which may be

ranked as one of the most notable of modern times, it remained for M. Hippolyte Fontaine, in connection with M. Gramme, to demonstrate it upon a real, practical scale. This was accomplished, more by accident than by design, at the Vienna Exhibition of 1873, and the history of the electric motor, since that time alone, would fill volumes.

When the fact of the reversibility of the dynamo became generally known, enthusiasts proclaimed that a revolution in the application and distribution of power would ensue, but that such has not so far been the case you all know. The electro-motor, like all other machines, has to be adapted to existing circumstances, and questions of economy have more to do with such matters than questions of sentiment.

As might be expected, one of the first uses to which the electromotor was put was the transmission of natural powers to centres of manufactures distant from the source.

All water falls can be utilized to drive turbines and dynamos without difficulty; but to transmit the electricity so generated to a long distance economically, presents quite a formidable problem. There can, of course, be no transmission without a conductor, and for the transmission of large powers correspondingly large conductors are required. M. Marcel Deprez has, perhaps, more than any one else, devoted himself to this problem; but the results that even he has obtained are far from satisfactory. According to his theory, the resistance of the line does not affect the economy of the transmission; but this evidently is based on the assumption that high electro-motive force is employed. His first actual experiment in long-distance transmission took place during the Munich Exposition of 1882, when he transmitted one-half horsepower over an ordinary telegraph wire from Miesbach, a distance of about 35 miles. He had long before that time devoted his particular attention to this subject, and since then he has on various occasions experimented with new forms of machines. The most recent of these has been on a line from Paris to Creil. Backed by a French syndicate, he has undertaken to transmit 100 horse-power over a distance of about 35 miles, using a silicious bronze wire 5 millimeters in diameter. He claims to have succeeded thus far in transmitting 40 horse-power with an economy of 50 per cent., under certain conditions, which it is not necessary here to discuss. But what, may well be asked, will these experiments result in? That power can be transmitted, we all know. Given, then, that M. Deprez succeeds in his attempt, will that alter the present condition of affairs, as regards the economical side of the problem? The cost of his installation, and the interest thereon, will far exceed the similar items, including maintenance of a steam plant of equal power, at the place where it is wanted.

Yet, paradoxical as it may seem, the great problem to be solved is not the transmission of 100 horse-power, but of thousands and tens of thousands. Now, this can only be done in one or two ways: by increasing either the electro-motive force or the current. If the latter plan is pursued, an increase in the size of the conductor must necessarily follow with its attending cost, and this is feasible, but not at present economical. On the other hand, can the electro-motive force be increased much beyond the limit which M. Deprez is now using? Dynamo builders know how perfect the insulation of the armature must be, and how little is required to burn one out under but slightly abnormal conditions. Those especially who have experimented with the 40, 50 and 60 arc light machines using two or three thousand volts, have possibly, on more than one occasion, witnessed an effect in the armature as if the latter had been struck by lightning. This effect is one entirely different from what would be produced in a machine in which the armature has been actually burned out by a heating of the wires from too great a current. The break resembles that made by a disruptive discharge, an actual spark; and M. Deprez has already experienced one of these mishaps, in spite of the fact that he uses two layers of silk and one of cotton for the insulation. The fact is, a dynamo of large power which is subjected of necessity to rough influences cannot be made to generate currents of very high electro-motive force for a continued service, on account of the impossibility of securing sufficient insulation. As has been pointed out in *The Electrical World,* the problem bears considerable analogy to that of the steam engine. The use of high pressure steam of, say, 500 or 1,000 pounds to the square inch, would effect great economy, but it is materially impracticable, as the cost of building engines and boilers to withstand these pressures would be out of proportion to the benefits derived, and no working joint could withstand the pressure. I have dwelt at length upon this question, as it is one that deserves careful attention.

For the reasons given above it would appear that as regards long-distance and large-power transmissions, substantial improvements are required before it can become a commercial success.

Leaving this part of the subject, the results of which are still in the tentative state, we come to the successful application of the electro-motor, by which power is transmitted to a limited distance. By far the most important progress made in the employment of the electro-motor is that in its relation to the running of railway cars.

Siemens and Halske deserve the credit of having installed the first electric railway in which the current was generated by stationary dynamos. It was at the Berlin Exposition in 1879 that a line of 550 yards was laid down, upon which a small locomotive

drew passenger cars merely as a novelty. Since that time the electric railway has been the particular study of many keen and active minds, and the application has extended considerably. This has particularly been the case where the motive power heretofore employed was supplied by horses. It must be evident that for equal power the use of steam, directly or indirectly, is considerably more economical than animal power, and hence for city railways in which steam locomotives are objectionable, the electric railway solves the problem.

Glancing at the various systems that exist, and that have been proposed, we meet a diversity which is the natural result of the labor of different minds. This difference consists not only in the method of leading the current, but the manner of distribution. Siemens and Halske's first railway was equipped with a central insulated conductor from which the current was taken off by contact brushes, the rails being used as the return, and this method has been largely imitated. The original arrangement has, however, been variously modified to meet various objections, the principle remaining the same. An overhead conductor has also been employed with success, in which a sliding contact is maintained between the conductor and the car. Such a system has for some time been in successful operation in various cities of this country, and also abroad.

For street railways it is evidently undesirable that pedestrians or animals should be liable to come in contact with the conductors, and another method consists in placing the conductors in a trench between the tracks, contact being made by an arm which passes through a narrow communicating groove. Other methods have been suggested and tried, but I merely mention these to indicate that the problem has been solved in various ways.

As has been stated before, the electric railway will, without a doubt, be the future one for city traffic. In our own country numerous workers have attacked the problem in different ways, and the success already obtained leaves no doubt for the future.

The question is often asked whether our great railway lines will ever be operated by electricity. It would be rash to say that they never will be, but under existing circumstances the present system will probably remain in vogue for some time to come. We shall, perhaps, see the first advances made in this direction by railways so situated that the item of fuel is of importance.

Thus far we have confined ourselves principally to the passenger electric railway, but an equally large field is open to the electric railway for other purposes. I refer particularly to its use in mines and tunnels, for the hauling of ore or other material. This has already been attempted in several instances, and with eminent success; and it seems strange that more is not done in this field, which seems such an inviting one.

As a cognate development of the electric railway, the ingenious system of "Telpherage," invented by the late Prof. Fleeming Jenkin, deserves attention. I need not describe it, as the subject is fresh in the minds of those who are acquainted with this subject. The telpherage system, however, marks a decided progress in the field of the application of electricity to the transmission of power, and the recent opening of an operating line at Glynde, in England, will no doubt be followed by the construction of others. The great flexibility and the cheapness of construction of the system eminently adapt it for rough localities, and telpherage also possesses elements of great value in making it possible to transport goods to the highroads of commerce from points which heretofore were beyond easy reach.

Since electricity has become practically available as a motive power, it has given a wonderful impetus to a number of undertakings which had previously been in the conceptive or embryo state. Chief among these is the art of ballooning. By the aid of electricity remarkable progress has within a few years been made in the way of an extended application of this heretofore uncertain method of locomotion. The recent experiments of Renard and Krebs have shown that the balloon equipped with the electro-motor can be depended upon for reliable service, and when the storage battery shall have been—as it will be—sufficiently improved as regards weight per stored energy, the balloon will have a value, both for purposes of war and peace, which can now be hardly estimated. Quite recently an ingenious method of transmitting power for the propulsion of balloons has been suggested by Gen. Thayer, of the United States army. His method makes the balloon captive to the conducting wires, which transmit electricity to a motor carried by the balloon. The system strongly resembles that of telpherage. In fact the only difference is that the balloon relieves the conductor of the weight of the passing load, which in the telpher line is carried by the conductor. When we consider the rapidity with which a line can be built, and the comparatively small power required to propel a balloon at a good speed, Gen. Thayer's scheme seems quite promising.

The war departments of various nations have taken up the subject of the application of electro-motors, not only in the navigation of the air as just mentioned, but of the sea, both on and below the surface. The torpedo propelled and steered by electricity conveyed from the shore or ship is fast superseding those propelled by compressed gases, and the fast torpedo boat deriving its power from the storage battery is now the subject of active experiment, the Russian navy having recently tried such a boat with good success. For small pleasure boats, the last method described will surely find extended application whenever

the storage battery shall have emerged from the difficulties under which it now labors.

The telegraph has also been advanced a step by the application of electro-motors. The latter has made it possible to obtain practically perfect synchronism in the revolution of two wheels placed at each end of a telegraph line. Mechanical appliances, without the aid of electricity, had been found inadequate for the purpose, and the small electro-motor alone has made the Delany and Calahan system of multiplex telegraphy a possibility.

Thus far the electro-motor has been discussed principally in its relation to the past. This, however, is a fitting occasion to cast a glance toward the future and to consider some points which are of special interest to this Association. I refer to a general distribution of power by electricity. In considering this problem, it may be well at the outset to set at rest some misconceptions which have unfortunately gained ground, due to the unguarded statements of enthusiasts. The question of economy is a matter of great importance here. The cost per horse-power per annum when using a stationary steam engine as the prime mover is a quantity variable with the conditions of the engine and the magnitude of the power. It is evident that a plant of one hundred horse-power or more can be maintained more economically per horse-power than one twenty-five horse-power or less. It would take me too long to demonstrate this by actual figures, and, indeed, the statement is so obvious that it hardly requires special demonstration. It is evident, therefore, that with increasing powers a point is reached at and beyond which the cost of power can be maintained in an independent establishment with equal economy to that of a central-station itself, but that below that point the power can be supplied more economically by electricity from a central-station. It would be impossible to lay down a universal rule as to this critical point in the power, for evidently it must vary according to locality and other conditions.

While the exact limits are variable, a slight consideration makes it evident that a general power distribution must be designed, so as to meet the requirements of a large number of comparatively small motors in circuit. I need not recapitulate the many attempts that have been made to supply the demand for a small motor to perform intermittent services of widely differing character. Modern civilization has created almost as great a demand for power as for such other adjuncts of convenience or necessity as light, water and heat. The advent, within the last few years, of numerous small gas, steam, water and petroleum engines, bears witness to this.

How many small workshops there are in which a reliable power from a central-station would be a boon? In how many situations

would such a small motor replace costly manual labor or animal power? A little consideration of this subject cannot fail to impress any practical man with its importance, and to give rise to the hope that it will soon receive the attention it deserves. When we consider further the fact that a double copper conductor, one square inch in section, is able to transmit 250 horse-power over a moderately long distance, without appreciable loss and without danger to life, and take this in connection with the present low price of copper, we must all admit the advisability of studying the problem of power distribution with the same energy as that of the electric light.

Several attempts have already been made to utilize lighting dynamos during the day-time for the purpose of running electro-motors in the circuits.

There seems to be no good reason why most electric light stations should lie idle and unproductive during 10 hours of the day when, with their spare dynamo or two to guard against accident, they could easily be converted into a power station. Reference is here made particularly to arc light stations (as they are at present in the majority) in which the wires existing are strung overhead, so that a motor in a building can be attached without any delay or interruption of service.

In order to make such a service feasible, however, the electro-motors employed, whether they be in series, as on arc circuits, or in parallel, as on incandescent lamp circuits, must be designed so as to maintain uniformity of action under the most varying external conditions. Uniform speed under all conditions of load is probably one of the principal requisites of any motor, and hence not less so of the electro-motor, and different constructors have solved the problem of securing the desideratum by mechanical or electrical means, into a description of which it is not necessary to enter.

But while good regulation is an essential element in a successful motor, that of high efficiency is of perhaps still greater importance. While the electro-motor has been the subject of extended study, it cannot be said that any definite and generally accepted rules have as yet been laid down regarding its construction, in the same sense, at least, as for the dynamo. That considerable remains to be done in this field, is evidenced by the fact that up to the present the efficiency of motors has, as a rule, been comparatively low. There seems to be no good reason, however, why the electrical efficiency of a motor should not, within limits, approach that of the dynamo, and the proper proportioning of parts and the study of their inter-dependence can alone bring about improvement over the present state of things. The efficiency, while comparatively low in large electro-motors, is still lower in the small ones, which is particularly unfortunate, from our point

of view, as it has already been shown that the small motor will constitute the principal factor in an electric power distribution. It may be set down as an axiom that a small machine rarely equals in efficiency a large one of the same type, but the difference which exists in the case of the electro-motor is in many cases out of all proportion and irreconcilable with the simple conditions involved. As has been recently pointed out in *The Electrical World*, the small electro-motor requires a thorough overhauling, and already one of our most prominent electricians has succeeded, by a series of experiments, in obtaining efficiencies in a small motor which have rarely been attained by the largest. These experiments are not yet finished, and hence are not ready for public discussion, but they will soon form the subject of general attention, as they mark a decided advance.

While recommending the utilization of electric light stations for power distribution during the day time, I would have it borne in mind that various conditions must be observed which necessarily enter into such a problem, and in which both the engineer and electrician could be profitably consulted.

The length already attained by this paper prevents me from giving more attention here to the history of electricity as applied to motors. I have already touched upon it incidentally. The sources of information on this branch of the subject are so numerous and so well known, that I have taken it for granted that electric light men are generally acquainted with the past, and that it is the present and future that is of the most practical interest and value to them.

The future of electro-motors was never so bright as at present, and when our electricians shall devote themselves to this field of applied electricity with the same zeal that they have shown in other departments, we may expect as great an advance in the solution of the power problem as has been effected by the electric light in that of illumination. The field is "white unto harvest," and only requires intelligent working.

I wish to say here, that in the preparation of this report I have received valuable assistance from Mr. Wetzler, of the editorial staff of *The Electrical World*, who has devoted much thought and attention to the transmission of power. In conclusion, I trust that this paper will have some effect in drawing the attention of electric light men to this important subject, and that we shall all live to see and enjoy the full realization of the expectation of early enthusiasts regarding the electro-motor.

MR. HOTCHKISS: I move a vote of thanks to Mr. Martin for the very able and interesting paper that he has read.

The motion was seconded.

Mr. Martin: I would like to have it clearly understood that Mr. Johnston prepared the paper, and would have read it to-day but for an attack of rheumatism contracted while attending the first Convention of this Association at Chicago.

Mr. Hotchkiss: In view of that I will withdraw my motion.

The President: I do not think it is a proper thing to offer a vote of thanks to any member of the Association for any service he may render. One or two members came up to the desk and suggested the offering of a vote of thanks to the Mayor for the very able manner in which he handled the question this morning, and for the kind, courteous and hearty welcome which he gave the members of the Association. I said to the gentleman who made the suggestion: "Don't do it." A vote of thanks in a Convention of this kind savors too much of buncombe. There is one other thing I want to say: This Association feels itself entitled to the best service its members can give without rendering any thanks for it; because, for that which they give they receive an equivalent in the contributions made by the other members of the Association. I want to be thoroughly understood, so let me repeat: If I present something to this Association, I am entitled to no thanks, because I expect to receive from the other members of the Association an equivalent in the contributions which they render. So I am very glad the gentleman has withdrawn his motion, and I hope such a motion will not be renewed during the sessions of the Convention.

The Secretary will now make an announcement to you on behalf of the Hampden Street Railway Company, who have extended an invitation to the members to ride over the road and examine the operations of the Daft system of railway.

The Secretary: The invitations entitling them to ride over the railway and investigate the station and plant will be in the hands of the Secretary to-morrow morning to be distributed to the members.

Dr. Moses: The very interesting paper that we heard read by Mr. Martin conveys, in one respect, an impression that I think we ought not to be too hasty in endorsing. It is that the Duprez experiments may possibly result in failure. Duprez is a very able man, and he has indomitable energy, and unlimited capital behind him. It is very likely that if the subject can be successfully handled, he is the man to do it. The difficulties that he has to encounter are probably paralleled by the difficulties that the first inventors of induction machines had to meet. They were considered insuperable, until Rumkorff, by his very thorough insulation, managed to make his induction machine so successful that we hear of machines that can give a spark a foot in length—the Spottiswoode machine, for example. Leaving Mr. Duprez to take care of himself, I would say that the methods of distributing electricity from central points, such as the coal fields, can be accomplished by low-tension machines. If, for instance, you burn your coal in the mine, and simply transmit it to the surface to be stored, you can, by a proper arrangement of a series of secondary battery systems, get your currents of any potential you please. You will then be able to insulate your line so that you can receive it safely at some city central-station; there undergo a re-transformation into currents of low potential, and distribute it then to the householders. That is probably the way in which we would use electricity manufactured directly at the source of the fuel.

Mr. Martin: Mr. President, I attach a good deal of importance to Dr. Moses' opinion. You [Dr. Moses] would have us understand that the current is at first to be a current of high electro-motive force, passed through a current transformer, and the potential to be adapted to the service for which the current is required in use?

Dr. Moses: From the secondary battery. For the first source I would have a dynamo machine in the mine itself.

Mr. Martin: Not at the mouth?

Dr. Moses: Not at the mouth, but in the mine itself; right at the coal stratum. You can get rid of your gases. There is even no necessity to elevate the coal. Transmit it by secondary batteries to the mouth of the mine. There put your secondary batteries in series, and use currents of five—ten thousand volts, if you please, to a point in the city where you can re-transform it safely, and then store it there, if necessary, or distribute it and re-transform it into the cellars of the householders. In a coil of very small dimensions you can transform a considerable amount of electricity.

Mr. Upton: I believe thoroughly that gentlemen who are running electric light stations are losing the very best thing they have. I think there is more money in the transmission of power by electricity from different stations than there is in selling lights.

Mr. Upton then read the following paper on "The Transmission of Power by Electricity:"

Mr. Upton: *Mr. President and Gentlemen*—At the Electrical Convention, held last August in New York city, in a paper I had the honor to read at that time, in speaking of electric lighting stations, the following remark was made: "There is one thing, it occurs to me, I think electric light companies should take into consideration, and that is the letting of power. At the Edison Company's Station, Lawrence, Mass., very many Sprague motors are used, which run all day. They use from half a horse-power to five horse-power each. These motors are all employed at a good profit, and it has always seemed to me that every electric light company should use its power in the day-time to run small machinery. You have it in your stations; why not use it?"

Since then, in every way, and from all available sources, information on this subject has been sought. Electric power, in many places, has for some time been sold from central-stations, just as steam-power is sold, and with profit to both seller and buyer. In Boston this has been done by the Daft Electric Power Company, using the Daft system, and considerations of the results here attained will suffice to show the commercial value of electric transmissions. Dynamos are run by an Armington & Sims Company's engine at a central-station, supplying electric power to about thirty motors in various parts of the city. It is sold at $150 per horse-power per year, the price at present being about the same as that for steam for small powers. It is a

curious circumstance that more power is sold than the engine can supply—a paradoxical state of affairs, explained by the fact that no set of machinery is kept running steadily, and the company supplying power gains by the stoppages. At this station they have in use two Daft dynamos, of 25 horse-power each, which are run by being belted direct to a 50 horse-power Armington & Sims engine. The steam is generated in a steel tubular boiler, set with the Jarvis furnace, in which coal screenings are used for fuel. This power is transmitted all over the city, to be used for running all kinds of machinery, including sewing machines, ventilator fans, printing presses, elevators, and other work. The demand for power far exceeds the supply, as the company has let all the capacity of their engine, and has applications for 300 horse-power more. It is the intention of this company to start a large central-station, to be run exclusively to let power. The present plant has been in operation over eighteen months, and the only interruption has been for three hours, when other parties cut their wires by mistake. In many cases these motors have supplanted small steam engines, gas engines and hired power. Customers claim that the power is more regular than they have ever used before, even when coming from the adjoining buildings. There is in Boston one engine running twenty-nine elevators. If every elevator was used at the same time the engine would not have over one-half the required power.

LOSS OF POWER BY TRANSMISSION.

From all the information gained, the actual loss in the process of conversion of power into electricity, and transmitting power from the dynamo to the receiver, amounts to about forty to fifty per cent. The manufacturers of the dynamos claim only a loss of thirty to forty per cent.; but it is a safe calculation to allow a loss of one-half. This, as has been explained, is more than made up by the excess of power that can be actually sold and paid for. Electrical transmission has the unparalleled advantage of being superior to the obstacle presented by distance. Then, again, it operates its miracles in perfect silence and repose. No force appears in the wire such as appears in shafting; in pipes, with compressed air or water; in endless chains or belts; and, in case of powerful currents, insulation is easy. The conductor can be bent or shifted in any way while transmitting power; provided, of course, its continuity be not interrupted. It can be carried round the sharpest corners, through the most private rooms, into places where no other transmitter of power could possibly be taken. There is nothing to burst or to give way. In short, such a method of transmission is the acme of *dynamical* science. At the present time steam is the foundation of electrical power.

Water-power is unsteady, and not reliable. Gas motors are of limited power. With improved steam engines, belted direct to dynamos, and the Jarvis process of utilizing low-priced, waste fuels, the cost of making power has been reduced within the past few years fully one-half.

ELECTRICAL RAILWAYS.

The most important use to which the principle of electric transmission of power is at present being put is the running of street railways. It was only a little over five years ago that the first electric railway was built in Germany, and to-day there are many in that country where their practical success has been demonstrated. In France and England they are fast becoming popular; but it seems that those in America are yet almost of an experimental nature. In this branch of electrical science, at least, America is far from being foremost.

The advantages of electricity over steam for railway purposes are many and great. In the first place, the bulky locomotive is done away with, as the electro or motor can be placed either under the car or on trucks by itself; in either case great weight and room being saved. The machinery for converting coal into the power, or rather extracting power from coal, is not portable, but stationary, and can be placed in the most convenient spot. For transmitting power, in many cases, no difficulty has been experienced in using one middle rail as the conductor. Sometimes it has been found that the dirt sticking to the rails and the wheels formed a sort of crust so insulating as to prevent adequate communication. From all the information I can gain on this subject, it is my opinion that the most practical way will be to use wires on poles. I understand this system is used in the West by the Van De Poele Company. The poles can also be made available for stringing electric wires for both incandescent and arc lighting. The future of this system is filled with possibilities. It will eventually become the motive power of all the present horse railways. In a few years elevated electrical railways will be as plentiful as steam railroads are now; and, in time, it will supersede the present system of running locomotives on all railroads; and, why not? It is simply a question of cost of making power. It is acknowledged by every practical engineer that the present system of making steam in locomotive boilers is expensive as well as wasteful. The evaporation of pounds of water to each pound of coal consumed to make steam in locomotive boilers does not average over three and one-half pounds of water, using the best grades of bituminous coal; while the stationary boilers, set to burn coal screenings for fuel, an evaporation of nine pounds of water to one pound of fuel is made, and the reduction in cost of fuel is from one-third to one-

half. It is only a question of time when all the different electric lighting stations in this country will use their engines in the daytime to make power to be sold for manufacturing purposes, the same as they sell power in the form of electric lights now. They can also furnish power to run electrical railways, elevated or surface. The economy of this system over the cost of running horses, as used now, will be over fifty per cent.

SPEED.

As to speed, it is impossible to give the limit which can be reached on electric railways, because those so far constructed are on streets or in localities where very rapid transit is not possible or desirable. On the very first one built a rate of seven miles per hour was customary. On the Berlin railway, opened in 1881, the greatest speed reached was at the rate of eighteen miles per hour. More was possible, but the police authorities refused to permit more than nine miles per hour. Up to August, 1882, there had been no breakdown on this road. On the Siemens' railway, at the Paris Exhibition of September, 1881, a distance of over 1,600 feet was traversed in a minute, which is at the rate of nearly twenty miles per hour. There is every probability that electric locomotives can be run faster than any steam locomotive now in use. About ten miles an hour is the average speed that a car can be run on an electrical street railway, but I think it is *possible* to run at the rate of 100 miles an hour. In the near future, on elevated railways, this will no doubt be accomplished. I believe the time will come when cars will be run by electricity between Boston and New York in about *two hours' time*, where it now requires six hours by steam railroads. We Yankees call ourselves *practical* people. We believe in the success of the use of electricity for elevated and surface street railways; and, believing this, we propose to put it into actual practical operation. Petitions are now before the present Legislature of the State of Massachusetts for charters for over a dozen street railways, part surface and part elevated—all to be run by some system of electric motors. In Massachusetts a horse railway can be started under the general law, but an electrical railway requires a special charter. A petition has been presented asking for an amendment to the general law allowing electrical railways to be started the same as horse railways are started now. We believe that the cost of power, as compared with the present cost of using horses, will show an economy of over fifty per cent. In the town of Winthrop, Mass., near Boston, sufficient money has been subscribed for erecting an elevated railway on the Enos system, to be run by electricity. The station will be constructed so as to include the use of dynamos for electric lights, and the elevated railway will be utilized for stringing

wires to run them. If the charter is granted, work on this railway will be started at once. The plans are all made for an electrical station three stories high, the upper stories to be used as a manufactory, and the power to be supplied from the station below—a most profitable way of utilizing the power of electric light stations in the day-time.

POSSIBILITIES.

The electric station of the future will be erected to utilize power in hundreds of ways not now thought of. Central-stations should be made large enough to combine all the present methods of using electricity, with full allowances for future discoveries, for I believe electricity *is in its infancy.* By this strange and novel agency power will be used to do its share towards the support and advancement of the human race. We may yet know, in our time, *what electricity is,* for to-day we only know it is a power that shows itself by its manifestations.

A professor in a college asked a student one day what electricity is. The student hesitated and tried to think of the correct answer, but in vain; it was of no use, he could not recall it; but, in self-defence, said: "I did know, but have forgotten." The professor replied: "This is terrible; the only man who ever knew what electricity is, has forgotten the answer."

Electric light and power stations, as large as our present cotton mills, will be erected in the future. The engines will be used in the day-time to run lines of shafting to furnish power for manufacturing purposes. Power motors will transmit electricity all over our cities to run small machinery. Both arc and incandescent lights will be used. Perhaps storage may yet be a success. Electricity will be used to drive machinery, to produce ventilation, for heating purposes; the exhaust steam will also be used for heating neighboring buildings in cold weather.

There is no need to expatiate upon the advantages to be gained from an economical method of transmitting power: the costly and persistent attempts of inventors and capitalists to get better methods are enough to prove their desirability.

Many systems have been tried and found wanting. In electricity, thanks to living inventors, we have a force into which power can be transferred as by the wave of the magician's wand; a force which flows to any distance with rapidity of lightning, and the stillness of a ray of sunlight; and, then, at bidding, resumes its original shape quicker than thought can follow it.

Mr. Weeks: I would like to ask Mr. Upton if he would use, during the night for lighting purposes, the

same engine and dynamo used during the day-time to supply power?

Mr. Upton: If arc light is run, no. If incandescent, yes. I understand that all successful transmission of power is done by low-tension dynamos—not over 500 volts.

Mr. Weeks: Then you regard it as practicable to run an engine and dynamo all the time?

Mr. Upton: Yes, sir. I think I would have a spare engine. I think that is entirely practicable. Now, as to running both arc and incandescent, there are several stations in New England that are doing it. If you choose to run an arc light system you can, by arranging your wheel and having the correct size of pulley, run low-tension, and you can run electricity for motive force all over your city.

Mr. Weeks: Then you would limit your motive power to your reserve?

Mr. Upton: I think there is more money in selling power at $150 a horse-power than any electric light company is making in this country selling light. I visited yesterday in New York the Gold and Stock Exchange. There is a motor of three horse-power that is running 300 tickers, and they are obtaining for that about $400 a horse-power a year. Now, none of you gentlemen can tell as good a story as that. If you sell it for a $100 a horse-power you are making a pretty good profit—that is, running ten hours a day in the winter. We have not come to eight yet. We may.

Mr. De Camp: I cannot see the difference between the arc and the incandescent unless we duplicate our plant. The lighting, whether it be one or the other, may be said to commence at four o'clock. Now we would either have to get our customers to dispense with the use of the motors at four o'clock or double our plant. We keep one reserve dynamo only. We do not duplicate our plant. We are just in that fix now. We run what would be a very respectable plant on daylight. We are running about 200 small motors; and while I am not able to say much about the motors themselves, yet, as I hear no objection from the parties

using them and paying for their service, I presume they are satisfactory. They are small motors, used almost entirely for the running of sewing machines. We charge for these motors a dollar a month. We do not make a contract for a less amount than five dollars. If a party puts in four motors we will run them for five dollars a month. That is, he can use one, two, three or four, but we do not make a charge less than five dollars. If he increases the number of motors we charge him one dollar a month for every additional motor he puts in. In other words, if he has ten, he would pay eleven dollars a month. They are supposed to be about one-twelfth of a horse-power. We, however, make the same calculations that Mr. Upton makes when he concludes that not more than a given number of motors are in service at one time. We run these motors on arc circuits with arc lights. Therefore, I cannot tell definitely just what they take. But, after all, for the kind of business for which people want some power, and have not the facilities for putting in power of that amount themselves, it is very desirable. It is popular. When we first started off, to a man who intended to use 300 motors to operate 300 sewing machines our charge was $301 a month. That, with the additional cost of the motor, which, of course, he would have to invest in, scared him off. They have what I understand is a very effective switch-board, which regulates the speed.

Mr. Upton: It strikes me, from what I have seen of electric light companies, that they are all about of the same calibre. They are after all they can make, and they are right. Now, if it is going to take more engines to put this question of the practical transmission of power in force you will employ them. I do not know anything about running arc wires. If it can be done, it is all right. Running at 2,500 volts, against some of those others running perhaps at 150, there is considerable difference. Now, I rode yesterday on four or five different elevators running a mile away from the stations, and they ran with perfect ease. The motor was in an upper story, in an inaccessible place, and locked

up. They oil it once a day, and leave it there. The elevators are largely freight elevators, but they told me that to run passenger elevators in that way was just as feasible. They would not be so fast as water elevators, but running them with such a motor would be perfectly practicable. I was talking to some of the people who are using the Daft system in Boston and paying $150 a horse-power. I think any of them would pay $300 a horse-power rather than not use it. I have been investigating that thing, and have been ashamed of myself that it has been running eighteen months under my nose without my knowing it. During the eighteen months it had only stopped three hours. They would not change under any condition. Now, if there is profit in that business, I think that you are going to make your stations large enough. You have the plant and everything connected with it. I think the time is coming when every electric station of the United States will be the foundation of power for electric railways. There are a great many parties East now who are selling their steam for heating purposes. You have not begun to develop your business. That is my idea. I suppose the people like the small motors you are selling. I investigated two or three systems. They have been running in the office of the Lawrence *American* for three years, and they have had no trouble with them since they were started.

MR. WEEKS: Suppose you have an open circuit with your elevator?

MR. UPTON: Have them all running the same time?

MR. WEEKS: Suppose you have an open circuit, and the circuit is broken?

MR. UPTON: They stand still, or they have a safety clutch. In electrical railways I think you will be saved from all accident. If one electro-motor runs a certain distance towards the other it will stop. This trial railway in Boston is run by a little wire a mile away from the station.

MR. MARTIN: I received a letter from the proprietor of the Lawrence *American*, of which Mr. Upton spoke a few moments ago. I had asked him his opinion as to

the service that he obtained from his electro-motors. He told me he was so well pleased with them he wanted to have nothing to do with anything else. He regarded it as a deliverance from the system that he had had previously, and he said that the saving to him was no less than forty per cent.

MR. UPTON: This Lawrence *American* is paying about $300 a horse-power. All the information I have gained is from low-tension dynamos; that is the only kind I have seen in operation. I suppose high-tension can be used with resistance boxes, or something of that sort.

MR. H. W. POPE: In the Diehl motors there is no resistance. The field magnet is adjusted. They work very successfully. I worked them myself on a high-tension wire and got a great deal of satisfaction out of them.

DR. MOSES: I would like to call attention to one or two points that have come up in the practical consideration of the subject. When the Edison central-station, that is located in the southeastern part of New York, was first established, they made a very exhaustive canvass of the district. They examined the location of every horse-power, not only steam horse-power, but actual horse-power; and they found many horses on the top stories of buildings. Electrical horse-power has not been used to any extent in the Edison district—although it is, to a certain extent, a manufacturing district, particularly north of Fulton street. Still they have not introduced it. We must look for the cause of that. The cause is this, I think: That it is not economical to run machines during the day that are more valuable for light-giving purposes. The quantity of power that would be demanded in that district is not commensurate with the amount of light that would be required in the evening. It will be a difficult problem to circumscribe electric light districts hereafter in such a way as to make the amount of power used in the day and the amount of power converted into light in the evening almost equivalent. Where you use low-tension currents the outlay for

conductors is so enormous that you will only locate them advantageously in districts where large quantities of light are used. A light district is a fashionable district. Fashionable districts have very few manufacturers. Now, that is where you are using low-tension currents. It is a different thing where you have a central-station with high-tension currents. So that the two combined systems seem to be the more feasible plan. The dynamos that are being used for light at night could be coupled up for power during the day. Using high-tension currents and a duplicate system of small conductors and higher potentials in the day to send out your current away from the fashionable districts into the working districts would, in New York, at least, accomplish this. There are places there which per square mile are considered the most populous on the globe, not excepting China. You could use your motors in the tenement houses in the economical method suggested. You could combine your light in the evening in one district, with your motive power in the day in another, either by using different engines, or using the same engines coupled up.

Mr. Upton: I would like to ask one question. If there is such a chance for introducing and transmitting power in that district, why have they not done so before? I made this same inquiry of the Edison Company. Their reply was that they did not have enough electric light machines to do it. They had done it so far as they could without interfering with their light. That station, in my opinion, was not successfully placed. Most of the lighting there occurs in the winter, between four and seven o'clock. Many think that perhaps it was thus placed as a trial. I do not think that anybody who examines that locality would place a station in that spot unless it is for power purposes. People come to me to buy small engines, and say that they would not buy them if they could get this electrical power.

Mr. Kerr: I am somewhat acquainted with the district spoken of in relation to its power. Dr. Moses referred to that part which uses a great deal of power,

north of Fulton street. Now, along Fulton street, and south of Fulton street, is a large number of jewelers who use considerable power. They use ten, fifteen, twenty, sometimes twenty-five horse-power for rolling gold; and this is a large size for electro-motors. Consequently, they use steam engines. North of Fulton street there is another cause which has not been mentioned. There is, on Beekman street, I think, a power station, which consists of a large engine, with a line of shafting that runs up some two blocks. It goes over to the *Herald* building and to Park Row. Power is already supplied in small quantities from that shaft, and it is pretty hard to get those people to change. That is another reason why you cannot sell electro-motors there.

MR. COOPER: Does that one engine supply all the power that is used there?

MR. KERR: No, sir; but it supplies that community with small motor power. In the manufacturing district the jewelers use considerable power, and can afford to run an engine themselves. That operates just at present against the feasibility of electro-motors, just in that particular part of New York.

MR. COOPER: I think I probably have had as much experience as any one here in regard to furnishing power and electric lights at the same time. When we started in Brooklyn, that being a one-horse town, we did not know whether it would support an electric light station or not, so we hired the power. When we wanted the power for lights, other people were using it, and we had to wait two hours or more until we could get it. In regard to dovetailing them you will find, I think, that would not be much of a success.

DR. MOSES: Not wishing to trespass on the time of the Convention at all I would like to impress as strongly as I possibly can the necessity of dovetailing districts into each other, *i. e.*, a district that uses light and a district that uses power, but using entirely different conductors; because if you dovetail power and light the difficulty you speak of arises. At four to six o'clock in the afternoon they both want their source

of power, and they conflict. But you want a light district during the night with light, and a power district during the day with power.

Mr. Cooper: But you never have that. Where do you get a place where you use the light at one time and power at the other? It is night at one district when it is night at the other.

Dr. Moses: Unless there were an intermediate link of storage between those points.

Mr. Cooper: Unless we arrive at something which has not yet been accomplished.

The President: I do not think the problem will ever be solved until the question of storage is.

The Convention then adjourned until the following morning at 10 o'clock.

SECOND DAY'S PROCEEDINGS.

The Convention was called to order at 11 A.M.

Mr. J. F. Noonan: I desire to offer the following resolution:

Resolved, That there be appointed a committee on transportation, to be composed of seven members—two from the South, two from the East, and two from the West—who shall furnish two sub-committees to report to the chairman, who shall be the seventh member of the committee. The chairman shall announce to the electrical press thirty days previous to the opening of any Convention whatever arrangements have been made with railroad companies for a reduction of fares to said Convention.

The resolution was adopted.

The President: The first business in order is the report of the committee on "The Best Equipment for Arc Light Stations and Steam Power, &c." Mr. Fosdick.

Mr. Fosdick: I wish to say that I was appointed upon this committee about two weeks ago, but was

unable to find that there was any special duty connected with it until arriving here. I tried to get the committee together yesterday morning, but was unable to do so, because one of them, at least, had other duties to perform. Yesterday afternoon I was told that this committee was expected to make a report, and was down on the paper for an address. The committee has no written address, and, semi-officially, I will make merely a verbal one, which will bring the matter before you for discussion.

The subject assigned to us first was "Steam Power," to which was added yesterday "The Best Equipment for Arc Lighting Stations." Electricity is dependent upon steam power. Although there are occasionally electric light stations run by water power, they are so few as really to need no attention at our hands. The basis of electric lighting is steam power; so that the best steam power is in reality the question which comes before us this morning. In regard to the best equipment for arc lighting stations, perhaps the original question was intended to include both arc and incandescent. The question of the best equipment is divided between engine and boiler. The best engine may have the worst boiler, and so give poor results. The poorest engine may have a good boiler and give poor results. But what we wish to decide upon, of course, is the best engine and the best boiler for given circumstances, and so it is really resolved into a discussion of the best engine and the best boiler. Those two questions will come before you this morning for discussion, and there will be, of course, those who can take both sides.

I recollect in the fall of 1879, at the Exhibition of the Mechanical Institute of Boston, there was on exhibition a Wallace-Farmer machine built at Ansonia, which had a carbon point perhaps five-sixteenths of an inch thick and three inches wide, and there was a Brush light, with the same carbon as used now. At that time the electric light was in its inception. The initial steps were then taken. The light was under severe criticism as a new thing. Unfortunately for the light, the dynamo was connected with a stationary engine which did not give a regular speed. The machines at that time were comparatively imperfect—the Brush machines—and the fact that this imperfect construction required for a perfect light a more regular speed, which it did not receive, subjected it to greater criticism as a new thing, and made the result of those lights a failure, so far as the acceptance by the public and by those who were exhibitors there was concerned. I was an exhibitor, but with no relation whatever to the electric light. At the close of the fair the

same Brush machine happened to be placed in a clothing establishment on Washington street, Boston, where it had a higher speed engine, making 220 revolutions. That same machine gave excellent satisfaction in its new place, giving a light which enabled those who had it in charge to draw the inference that the effect of a regular speed was to give a perfect light. Of course, from that time to this, the electric machine has been steadily improving, so that there is not now the need for that close regulation for the arc light which there was then; nor is there the same criticism of the light, because it has come to stay. At that time, close regulation being essential, the engine chosen to run the light was considered more in its relation to regulation of speed than to close economy of operation, the object being to get a successful electric light, and it was then found, as is true theoretically, that the higher the speed the closer the regulation. It is very true that the higher the speed the better is the rotatory effect; consequently, high-speed and electric lighting went very much together in the initial steps. Hence, high-speed engines went with electric light dynamos; and it has been hard until the present time to disassociate these two ideas.

Of course, electric lighting competes with gas, and there comes up immediately the question of comparative cost between the two. An electric light in our stores or on our streets will replace a certain number of gas jets and give satisfactory results. The question has been not altogether the amount of light, but rather the lighting of a given district. And just as soon as the question is settled that the electric light is a success, then comes the question of economy. Of course, those who build high-speed engines had the advantage. Those building low-speed engines went to work to put them in a position to be used for electric light purposes, and within the past two years the question has come prominently to the front, whether, all things being considered, high or low-speed engines are the best. There are those who have made experiments both with the high and the low-speed, and they, of course, are the best qualified to decide practically as to the merits of the two systems. It is a fact that many of the largest stations in our country to-day are fitted up with low-speed engines, higher, perhaps, than the old low-speed, but still "low-speed" compared with engines of the distinctively "high-speed" types. These stations are giving marked economy; and where there has been a direct comparison, the decision has been that the light with the low-speed has been equal to that of the others, the economy being much greater. It is also true that the larger the engine the closer the economy, regardless of "high" or "low" speed. The question, then, comes in as to whether not only low-speed is economy, but whether, without regard to the power of the engine, a low-speed engine of a given

power is more economical than a high-speed engine of the same power. There are certain elements of lack of economy entering into a high-speed which are inseparable from it. These are increased friction and increased clearance in proportion to the power of the engine. The principal element of loss in a low-speed engine is the necessity of a line shaft to belt from, because it is almost impossible to belt from the pulley to the fly-wheel. The question, then, is whether the belting direct, and the loss by clearance and these other items, more than offset the question of the extra friction required by the line shaft. I think the majority of the committee who have this matter in charge will decide in favor of the low-speed engine. I think I may say that, although I represent merely my own views. That matter will come up for discussion here, and we shall hear the question argued pro and con.

There are certain places where high-speed engines must come in of necessity. Lack of room in many cases prevents the application of the longer stroke and cylinder engine, and of a line shaft, which are essential with a low-speed engine. So that in certain cases, regardless of economy, there must be the high-speed engine. It has its places, and those places cannot be taken by the other.

The second division of the subject would be the question of boiler. On that subject I am not prepared to speak very positively; but we shall all agree that in this matter we require the best boiler, which opens a question upon which men's opinions vary as much as possible. The opinion of the committee, perhaps, would be that the horizontal tubular steel boiler, of proper dimensions, is the best for use in electric light stations. The proportions of the boiler, although opinions vary somewhat in regard to that, would be for a size of perhaps 100 horse-power—such a proportion of grate surface to heating surface as 1 to 30; such a proportion of tube area to grate surface as 1 to 7½ or 8; such a proportion of tube length and tube diameter as 45 to 60. The size and the diameter of the tube depend somewhat on the fuel used—larger for the lighter fuels, smaller for the more solid. The distance also from the grate to the belly of the boiler is a question on which authorities vary; not less, in any case, than 24 inches; nor greater, in my own opinion, than 32 inches.

As to draught, I think we too often err on the side of small chimneys and a little draught in the construction of electric light stations.

Together with this, there should be a very careful setting of the boiler, according to the very best plans that can be furnished, even at some additional expense. The setting of a boiler has a great deal to do with its efficiency; and, I believe, that after a

boiler has been set four or five years, it would pay to have it pulled down and reset.

There are other questions as to equipment—questions of pumps and injectors and pipes, etc., which are properly under the control of a competent engineer having charge of such matters.

Gentlemen, this has been simply a very crude address, something I had not anticipated doing at all when I came here yesterday; something which has had only a few minutes' attention, and is given simply for the purpose of opening a discussion on this subject. It is wide enough for all to take part in it, and I presume that the session this morning, if the President permits it, will be taken up by this. All of us have more or less experience in the practical application of steam to electric lighting purposes.

Mr. Upton: As I was on the committee on "Steam Power" I wish to say that while we did not all agree, I think the report of the chairman is a very fair one, and very well put. I have very few criticisms to make. Of course, I am a high-speed man. I think that, so far as my experience goes, at least half the stations in the United States use high-speed engines, all arc light stations, and at least three-fourths of the incandescent. There are places where the high-speed are much better than long-stroke for incandescent purposes. Almost all the stations that started in on long Corliss engines were obliged afterwards to put in the short-stroke. That has been the experience in many places, and in several we have changed from high-speed to low-speed. I think there are circumstances where the long-stroke engines have been of great advantage.

In regard to boilers, I agree with Mr. Fosdick. Our experience has been in favor of a six-foot steel boiler, with 130 three-inch tubes, giving, as a rule, where we have tested them, by indication, 150 horse-power. In putting in electric light plants, as a rule, we always put in that size boiler. We have, at present, between forty and fifty stations; and, I am happy to say, that without one single exception, all are on a dividend-earning and paying basis. I think that settles a great many difficult points.

Mr. De Camp: Though we may talk here a great deal on the merits of different types of boilers, we cannot

come to any conclusion. It is not a question of moment to the members of the Association, except those who are building new stations, or who are increasing those already built. In fact, a large portion of the electric light stations, both public and private, are using the high-speed engines; and it has been, no doubt, the general impression that the high-speed is absolutely necessary to the proper efficiency of the dynamo machine. But that was simply a theoretical opinion. We changed our minds about that for reasons which I stated at the last Convention; and whatever change has taken place since then has had the effect of confirming us in those conclusions. The questions to be considered by us at present are of equal importance to all who are running central-stations. With our original plant of a large number of independent engines, the first consideration was absolute safety. We are a company organized, and are serving the public, who are severe censors of any defects there may be in our operations, whether there is a reasonable ground for them or not. Therefore, we must protect ourselves against that criticism. Hence the multiplication of engines. We are certainly about as well protected as it is possible to be; but after running two or three years, we have come to the conclusion that the necessity for that extreme caution is not so great as we thought it was at first; and that we can protect ourselves in other ways. Now, we are using six small engines and a number of large engines. We have never had any serious mishap. By an accident on our main line of shafting at one time we had all the lights on that shaft out for about twenty minutes; and when we got into shape, at the end of that time, we were obliged to cut off seventeen out of a total of some 700 lights. That was pretty lively sort of work—showing what we could do in an emergency. I repeat what I said before: that we have found, by actual experience, in making an even run, that it is equally economical for us to run a pair of large engines. In making a test, with a view of finding out what would be our best policy, I said to the engineer: "Just fill up

your bin there as usual." (We have our coal put in our bins every day). "We will run it for a week, and then change over and run the other engines for a week." The result of the experiment was that we have ever since run the large engine. Although we are running an engine of that size to do the work of a few hundred horse-power, we have gone further than that, and found that we can reduce that load with equal economy—that is, so far as fuel is concerned. We run a treble 48-inch belt, which gave a very considerable back pressure. Now, of course, we crowd on to our large engine, for economy's sake, all the load we can. That load comes from four to half-past six, when we have the most lights in service. If we have a breakdown at that particular time, it puts us in a very awkward position. The accident we had to our shaft occurred just at that time. It never occurred but once. It might occur again. What we want to do now is to put in a single engine on the other end of our line shaft, coupled on the same shaft, which can be run during the day up to 3 o'clock, and afterwards thrown in on the big engine, without stopping our shaft. The only obstacle which we have met with in making this arrangement is the want of an efficient clutch. I think that if a clutch can be devised which is entirely reliable to clutch in and out a heavy shaft, with a heavy load, running at high-speed, with perfect safety, we can equip our stations, of any size, with very large engines of the highest efficiency, and make ourselves practically safe. If we do that, I would not be in favor of dispensing with our eight small engines. If we put in a large engine, such as I suggest, we will have to take out four of the small ones. I would not, under any circumstances, dispense with four small engines, on account of their exceeding convenience. We have two of these engines coupled together. After running four or five months a crank-pin on one side broke. It fortunately happened just about the commencement of the afternoon lights. We had prepared ourselves for an emergency of that kind. We had tackle and everything arranged. It took, by the watch, I think, about seven and a-half

minutes to unlimber it, and put the other one immediately to work; but we had to carry our afternoon load on that engine. We run 483 lights on that side. Of course, we recognized that there was no economy in running that way, but we were saved. Our customers did not know anything had happened to us, and everything went on until we repaired our crank.

But I would like to have the question of clutches discussed here. I think everybody is interested in it. I think, as the business grows, we will all be running under similar, if not the same, conditions. We have two plants in one. We cannot ignore our day business. We have 250 or 260 day-lights. Of course, we would rather have them at some other time. We have the all-night lights, particularly the public lights. The consequence is, we have only four hours of an economical load on our engines; and I do not see any way of getting around it. If we could have an engine of half the size to run on this day-load, and use this large engine, say, from four until twelve o'clock at night, and then get off on to a smaller engine, worked up to its economical point, we would get at the highest economy in motive power, and, with a coupling such as I suggest, be absolutely safe, so far as having any lights out by reason of a break. We have had several discussions on the clutch in our station, and our consulting engineer has been traveling with instructions from us to make careful note of all clutches he saw or heard of. He has as yet reported nothing to us that, in his judgment, we can depend upon.

I mention these facts merely to indicate what, in my opinion, as one having had considerable experience in electric light stations, is the best method of equipping light stations, both for economy and safety.

The President: The Convention will be very glad to listen to Mr. Evans, of Baltimore, who is on this committee.

Mr. Evans: Our experience in Baltimore has been very similar to Mr. De Camp's. When we started we tried a small engine. We replaced it with a larger one, and from several tests that were made here and at

Norfolk, Virginia, it has been demonstrated very plainly that there is more economy in running the long-stroke engine. I see no reason why, with proper management and care, such an engine should not give as good, if not better, results than a high-speed engine. A great objection to high-speed engines is, that if anything gets loose the engine must be stopped for re-arrangement. But with the long-stroke engine all the parts can be examined while running. We ran five Buckeye engines for three years in Baltimore. Not one, after being once started up to run its watch, was shut down during the whole time, for any cause whatever. The Ball engine, which we put in four months ago, has so far given very excellent results; but, comparing the amount of friction on that engine with the friction of our large one, I find there is more economy in running with a long-stroke than with a high-speed engine. The Armington & Sims, and several others, which have been tested at Norfolk, have been giving very good results. But I think if the Norfolk people had to re-build their station they would certainly put in a long-stroke engine. Their consumption of bituminous fuel ranges from 56 to 62 pounds per lamp; whereas here in Baltimore we use an average of about 36 pounds for the same number of hours run. It is true, as Mr. Upton states, that in New England they have been introducing the high-speed very extensively, but I think there are two reasons for that. One is that in New England, when a station is built, the equipment is complete—engines, machines, lamps, and boilers. With them it is not a question of economy as to the running of the engines, but as to the cheapness of the plant, which is accomplished through the placing of high-speed engines. The other reason is that they have not yet had sufficient experience with long-stroke engines for electric lighting. A few stations have adopted it; but the majority are started in a small way with the intention of getting close regulation from a high-speed engine, and for that reason I think the high-speed engines are so largely introduced into the Eastern stations. But our experience in Baltimore is in favor of the long-

stroke engine, both as to economy with regard to friction and as to safety.

MR. WEEKS: Can you say something on the subject of clutches?

MR. EVANS: We started with a very extensive plant of $16,000, including the shaft and clutches. I am sorry to say that they were a complete failure, and we have taken them all out. We adopted the fast and loose pulleys, which have given us the best result. I do not know of any clutch in the market that is capable of undertaking the electric light work. Certainly the clutch we had at Baltimore was a failure; and from the reports of others on the market, it appears to me they are going the same way. A clutch is probably the thing we need. For instance, with fast and loose pulleys, there is once in a while a time when it is necessary to shut down for a few seconds, so as to get the machine in order again. We cannot do it as rapidly without a clutch. The great trouble with the Frisbie clutch is in the connection they make from it to the shaft.

As to boilers, ours are very large. We are using the Jarvis furnace. We had three boilers that were set with the retort furnace, which were a complete failure. We changed them back to the old style, and I must acknowledge that the Jarvis furnaces are evaporating more than those three boilers. It is certainly doing everything we expected from it here in Baltimore. We use about thirteen tons of coal a night. The evaporation of the Jarvis furnace makes a difference of about three pounds of water per pound of fuel over the ordinary furnace.

MR. CLEVELAND [in the chair]: If Mr. McGrath, chief engineer of the New York Brush Company, is in the room, I will ask him to address the Convention on this subject.

MR. MCGRATH: *Mr. Chairman and Gentlemen*—We were probably the pioneers of electric lighting in this part of the country. We commenced in the fall of 1879. We used what you would term the low-speed engine; in other words, the Corliss engine. At the

time we commenced business electric lighting in the East was very little known; in fact, it was very little known in the United States. We started with one 18-inch Corliss engine, with which we ran one 16-light Brush dynamo. We had 16 lights on Broadway, New York, between Fourteenth and Twenty-fifth streets. We afterwards extended our lights to Thirty-fourth street, and continued that for about a year. Our business gradually grew up. We added another 18-inch engine of the same make, and have continued to use the same style of engine. We have now in our stations a plant of about 1600 horse-power. It is nearly all made up of what we term the slow-speed engine. Our arrangement of stations is probably a little different from that of most stations throughout the country. Each of the engines is coupled with what we call an internal gearing, so that we get the advantages of a high-speed engine without the disadvantages. We do not take up the amount of room that would be required with a long line of shafting; nor do we have any disadvantages which arise from a high-speed engine running and coupled direct. Each engine has its own set of machinery, which includes about 145 lights. We find there is no economy in using clutch pulleys. Each dynamo is belted direct to the line of shafting, which takes up but little room. We keep on each engine one spare machine, so that, should anything occur to one of the dynamos in use, we can easily switch that circuit on to the other. If a machine should burn out between the armature and the commutator, so that it would be necessary to stop it, it necessitates putting out that whole circuit; but if you have a spare machine, it is an easy matter, without stopping, to simply switch the circuit on to it. The last engine we put in, which is much larger than the other, and develops about 400 horse-power, is belted direct to our line of shafting, and our machines from that line of shafting are belted to it in the same manner. We find that we can run in that way with economy. We have also two small Ball high-speed engines that make a great number of revolutions a minute. The piston speed of those engines is

not as high as that of our large Corliss engine, but the rotatory speed is greater. The engines are small, and we are not in a position to judge the difference between the efficiency of one compared with the other, as we have not the facilities for making a fair test. Our experience with the large engine has been satisfactory, and from that, and from what we have seen in other stations, we are satisfied to use the slow-speed engine.

As far as boilers are concerned, we use what is known as the plain tubular boiler. Our boilers are 16 feet long by 5½ feet in diameter. We have fifteen in use. We use a setting that is known as the Jarvis furnace, and we flatter ourselves that we are getting about as good results from our plant as there is in this country anywhere, both in economy and in durability. Most of our machinery has been running for a little over four years. We have never been obliged to stop one of our engines for any purpose whatsoever. We have never had occasion to reset one of our boilers. I would say that I think our boilers to-day are in as good a condition as they were the day we started them. Of course, we have to make incidental repairs. There is a great point in regard to stations, which people do not seem to consider, and that is the rnnning of electric light machinery. It takes too much time, in case of any trouble, to change from one machine to another, or from one engine to another. What the customers want is to have a steady, continuous light. Now, if an electric light station is properly equipped, there will be a switching arrangement in order to stop any engine or any machine in any part of the station, and change it on to another machine in another part of the station, without any loss of time. There is no difficulty in doing it at all. We have two stations in New York. We have one in Twenty-fifth street; another about a mile and a-half further down town. We have our wires so arranged that we can stop the Twenty-fifth-street station and change them on to our Elizabeth-street station, and not have a light go out. If you are watching the light you will see a sudden flickering. If it can be done in this way, it certainly can be done by

changing one machine in the same building and placing another one on. That is what the public seems to demand—a steady, continuous light.

MR. MORRISON: How do you do it, Mr. McGrath?

MR. MCGRATH: I will tell you later. It would require a long explanation.

MR. DE CAMP: Do you ever reverse your machines?

MR. MCGRATH: Quite often.

MR. DE CAMP: How do you get over that?

MR. MCGRATH: Rush them back.

MR. DE CAMP: Will your lights be out during that time?

MR. MCGRATH: Out? No.

MR. DE CAMP: I don't know anything about the matter myself. I have spoken about it several times to our electrician, and he says there is no difficulty in doing it, but he is afraid of bursting the machines. What the effect on the dynamo may be I do not know.

MR. MCGRATH: On the Brush machine it would have no effect at all. The machine would simply generate in the opposite direction. You can reverse the poles and it will generate again just the same as before. It is possible to reverse the machine in doing that, but you must get the contacts made before they are broken. That is one danger in doing it.

MR. COOPER: Suppose something happened to the large engine you spoke about, how would you keep your lights going?

MR. MCGRATH: We have several other engines to which we can change.

MR. COOPER: Then you have a reserve power; at least, your plant is duplicated?

MR. MCGRATH: We have no reserve power at certain times in the day. At this time of the year nearly the whole of our power is running.

MR. COOPER: If at that time an accident should happen what would you do?

MR. MCGRATH: We would have to stop.

MR. COOPER: What kind of fuel do you use?

MR. MCGRATH: We burn about twenty tons of buckwheat anthracite coal a day at this time of the year.

Mr. Cooper: How much does it average to a light in the run, in pounds?

Mr. McGrath: I do not know. We never figure pounds. We figure everything in dollar's worth. It doesn't make any difference to us whether we pay $10 a ton for coal or $1.50.

Mr. Cooper: It does to us.

Mr. McGrath: The gentlemen must not misunderstand that. We go by the quantity of electricity we can get out of a dollar's worth of coal, and not a pound of coal.

Mr. Upton: How much coal do you burn per lamp per hour?

Mr. McGrath: I cannot tell you without referring to memoranda, etc., which I have not with me. But it costs about $2\frac{9}{10}$ cents for each lamp for ten hours. I will leave gentlemen to figure it out. That is a 2,000 candle-power lamp.

Mr. De Camp: Suppose that in the aggregate you burn 40,000 lamps in a month, and the cost of the coal consumed for that time is $2,000, do you divide the cost by the number of lamps to get that result?

Mr. McGrath: If you take into consideration the number of hours the lamps burn.

Mr. De Camp: Well, would that be your way of arriving at it?

Mr. McGrath: No, not exactly.

Mr. De Camp: Ought not that to produce the result?

Mr. McGrath: It may produce the result. But I am giving the result for each ten hours.

Mr. De Camp: I will go further then. This is my method, and I inquire for the sake of comparison. I have what I call a circuit report, in which is kept all the lights in service. Each day the number of lights and the time that each circuit is running are recorded. This gives us the number of hours per day. At the end of the month the result gives us the total number of lights and the total number of hours per month. Now, if we divide the number of hours by the average number of lights, it gives us the average time. We agree with you in not considering the pounds of coal.

It is a matter of dollars and cents. We divide our money spent for coal by the number of lights we burn. It gives us the cost per day in dollars and cents of our lights. Now, if we want to get the cost per hour, we simply divide that by the average number of hours. Now, is your $2\frac{9}{10}$ cents per lamp per day made up on that basis of calculation?

MR. MCGRATH: It will be more than that, for the reason that our lamps at this time of the year average to the run more than ten hours.

MR. DE CAMP: What we want to get at is on the year's business. Our average run for the whole year through is eleven hours and eighteen minutes.

MR. MCGRATH: The average of lighting for the year will depend entirely on the number of all-night lights and the number of one o'clock lights run. Say you have three or four hundred lamps that run all night and a hundred that run until one o'clock, the average would be materially different from what it would be if it was *vice versa*. Our lights, I think, average more than twelve hours. We run a great many lights in the daytime.

MR. DE CAMP: Is this $2\frac{9}{10}$ cents the average for a year or for some particular month?

MR. MCGRATH: That is the yearly average.

MR. DE CAMP: Why do you base it on ten hours run, when the average is twelve hours?

MR. MCGRATH: We are not saying what it costs us to run our lights in New York. I am simply giving what it costs to run our lights for ten hours each day at the present price of fuel.

MR. LINNELL: May I ask what is the price of fuel?

MR. MCGRATH: It is hardly a fair question to ask of me, because we buy coal at a price we do not make known. The price of coal in New York varies largely, according to the quantity, the purchaser, and how it is bought.

MR. LINNELL: What would be the usual price to the ordinary consumer?

MR. MCGRATH: About $3.

MR. COOPER: Is that per gross ton, delivered?

Mr. McGrath: Yes, sir.

Mr. Morrison: Let me ask you a question in regard to that switching apparatus. Have you made any change in the method of switching lights since you installed your new station?

Mr. McGrath: We put in a new switch board since that was built.

Mr. Smith: In calculating the price of coal consumed per light, are you merely reckoning the lights burning or the waste on the line also?

Mr. McGrath: We are reckoning the lights burning.

Mr. Smith: I have a line of four miles. I lose current equal to three lights on that line. So in reckoning the cost we always reckon three lights over what are really burning.

Mr. McGrath: We do not. I only reckon the actual cost of the lights burning.

Mr. Cooper: Did I understand you to say that you have a reserve dynamo for each engine?

Mr. McGrath: Yes.

Mr. Cooper: You say you run an average of 145 lights on each engine. Then you must have at all times a third of your capacity idle?

Mr. McGrath: We do not keep a 45-light dynamo in reserve. We are never running less than two or three engines at a time.

Mr. Cooper: If you have one dynamo idle for each machine, you must have at least one-third of your whole capacity idle?

Mr. McGrath: When I say we have only one dynamo on each engine, that is practically so. But if we are running four engines, we have two idle dynamos. If we stop one engine, we still keep two dynamos idle.

Mr. Cooper: With your arrangement of switching you can switch any dynamo?

Mr. McGrath: We can switch any dynamo on any circuit. We keep one or two dynamos in reserve all the time. If we are only running one engine we keep one reserve dynamo on that.

Mr. Evans: Would it not be advantageous to you to have a fast and loose pulley?

Mr. McGrath: My experience with fast and loose pulleys on dynamos has been such that it takes as much power to run them as the dynamo. Very often when you want to use the fast and loose pulley you cannot stop the machine.

Mr. Evans: So if the machine is disabled at ten minutes past six it runs till morning?

Mr. McGrath: It runs till all stop.

Mr. Morrison: Which goes to show that the New York system is not as perfect as the system used in some other parts of the country. I rise to say that the meeting of this Association in Convention is for the purpose of eliciting information which may be for the advantage of those engaged in the electric lighting business. New York being the centre of that business, we expected a great deal of information from Mr. McGrath. As to the matter of changing his machines without any appreciable darkening of the lights, that is done where every well-ordered station exists. My question was to find out what particular method, if any, had been adopted by the New York station, so that the rest of us may have the advantage of it. The New York station, when first equipped, was arranged with the same sort of switching arrangement that the old Twenty-fifth-street station, in New York, had. I have not seen it since then, and I did not know but that the gentlemen in New York had invented a plan by which they could handle this thing better than we do in other parts of the country. But I find from the question of Mr. Evans that, if a machine is disabled, he must keep on running all night long. Now, a condition may arise whereby a machine being disabled will so connect itself that, unless you stop the machine, it is going to set things in a blaze. So that there is a clear case where the entire plant on that engine would have to stop in order to get rid of that machine.

To return to the switch-board arrangement again: It is quite common for the Baltimore men to make the changes suggested by Mr. McGrath. For various causes we have just a barely perceptible darkening of the lights. Our switch-board is arranged with swinging

jaws, and into the jaw is introduced a plug-switch with a wooden handle. The handle is hollow, and the wires are carried up through the handle to the solid part of the plug. The switching is done simply by operating quickly, and introducing the plugs again. I am going to ask Mr. Orford, of Bridgeport, to explain the method of shifting the machine without having any darkening of the light. I think they couple two together, and then disconnect one.

Returning to the subject again of the New York station: As to the matter of estimating the cost of fuel in dollars, I hardly know how to touch that subject without treading on some one's corns. I will just say this, that this is the method which seems to be adopted by the gentlemen with whom we have been in correspondence who do not want to tell anything. In our station we use a mixture of slack soft coal and anthracite screenings—three tons of screenings with one ton of soft coal. Of that mixture, we use four pounds and a fraction per lamp per hour, varying to some extent, under certain conditions with which you are all familiar. Now, these are things that I want you all to know, as far as we are concerned. The price of that fuel varies a little. In the month of January, 1885, we paid $1.90 a ton for the mixture. In January, 1886, we paid for it $2.10 a ton. Owing to this storm, which is something very unusual, we are unable to get the screenings into the station. We burn quite a large quantity of it, which gives you a reason for the increase of price. Now, two nights last week we ran out of screenings. We then ran our engines on the bituminous coal entirely. The cost of that coal was about $3 a ton. We found that instead of four pounds and a fraction, we were using three pounds and a-half. Am I right?

Mr. Evans: That is right, sir.

Mr. Morrison: Three pounds and a-half per lamp. The difference in the cost between the mixture and the clear bituminous coal was very much in favor of using the mixture. Of course, you understand we now use the Jarvis furnace, which I consider that all well-

regulated electric lighting stations should use. We are trying to bring about an economy of fuel. It was not my purpose, when we opened this Convention, to occupy any portion of your time during its sessions. But you are asking for information which the gentleman from New York denies you. This same information I must give you from the station in Baltimore, which we deem to be immeasurably better conducted than the station in New York. We believe that the Baltimore station is about the only one in this country from which can be obtained an absolute knowledge of the cost of producing arc lights. There is not a single item of expense, direct or indirect, that is not taken into careful account. The cost of our lights is based upon the total expenditure, both administrative and executive, including the interest of the money expended in our plant. Now these figures we desire to give you as far as practicable. We do not intend to tell you in open session what it costs us to make a light, because we are afraid it would be so great in comparison with the earning capacity that our stockholders would give up their investment. But there are certain points of information to which you are entitled. You have come here at a considerable expense to your companies. This entitles you to all the information which it is possible to give without interfering with the internal economy of some of the companies.

Now, the matter of engines has been thoroughly gone into by Mr. Fosdick, Mr. Upton, and other gentlemen. We pronounce in favor of the large engine. We use what is known as the high-speed engine. But we use the large engine. We do not believe in coupling directly to the dynamo. In one case, however, we use a Ball engine connected to one of the twenty-six Brush machines, 65 lights, and in that case we have an illustration of a direct belting with an extremely high-speed. In the other cases we use the Buckeye engine, 15x30, and 16x32, a description of which you have had on two or three other occasions. I repeat to you what I said in New York and Chicago: If we were to increase our plant now we would put in a 600 horse-power engine instead of six of 100 horse-power each.

The question of safety, which some of the electrical managers plume themselves so much upon, is simply a duplication of the plants. If a station can afford to have a plant for 200 lights when they are only running 100 lights, then it is all right. They may enjoy the privilege. But there is not an engine in the world, whose ultimate capacity is a hundred lights, that you can arrange in such a way as to be able to run two hundred lights on it. A horse can pull only so much of a load. If you put double that load on, he is going to stop. An engine is simply an iron horse. It has its ultimate capacity, and if you go beyond that the engine will stop. Now, the problem may be solved by any of you who are running electric lighting plants, and who desire to provide for those contingencies which might possibly arise, but which are very improbable if the engineer properly performs his duty. Of course, there may come a time when you will have a breakdown of your apparatus in spite of the utmost care. But the average breakdown is due more to the inefficiency and ignorance of the engineer than it is to the engine itself. A well made engine I conceive to be one of the most perfect pieces of machinery that ever was built; and you are pretty sure to have a good machine if you buy from a first-class builder, particularly one of those who have established a reputation in our line of business.

The cost of producing lights is based first upon the cost of fuel per ton delivered in the station (these items that I have given you for the Baltimore station are based upon the coal delivered in the station); next, upon the cost of the carbons, which have been very materially reduced since we first began this business, falling from $65 down to $10 per thousand.

Mr. Cooper: Is $10 the market price now?

Mr. Morrison: For some kinds of carbon.

Mr. Cooper: The kind you use in Baltimore?

Mr. Morrison: No, sir.

Mr. Cooper: Then I don't think it is quite right to mislead in regard to that.

Mr. Morrison: Mr. Cooper, you will remember the explanation made by Mr. Fletcher. He had two kinds of carbon—winter carbon and summer carbon. That is the fact. The latter is a very soft, but not a perfect carbon. I won't tell you who made it. I won't give the man away, as Fletcher did.

Mr. McGrath: I would like to ask the gentleman if he gets as nice lights from the soft carbon as from the other?

Mr. Morrison: We get as good lights as you get in New York. Our lights—I now speak from personal observation—compare favorably with those of any other city that I have visited. I mean both the Brush and the United States Company. There are lights here that are equal to any in the country, and better than those in New York. We do not confine ourselves to the use of Brush carbons. We consider that we are entitled to an open market on everything pertaining to electric lights. But I won't go into that. The courts have decided that there is no patent on carbons. We bought a patent on carbons from the Brush Company, but the decision rendered by the courts was that we had bought something that was not valuable at that time. Therefore, we buy carbons wherever we can get them. We have used the carbons of the Boulton Carbon Company, the Parker-Russell Manufacturing and Mining Company, the Pittsburg Carbon Company, and, of course, the Brush Company. We use more largely of the Brush carbons than of any others. We will use more largely of the others than of the Brush, unless the Brush Company reduces the price very materially.

Now, the next point is superintendence. A skilled superintendent who takes an interest in the company's business, who does not feel that he is a hired man, one of those who are constantly watching the clock and whose motto is "Come day, go day, God send pay day," who will demand a fair day's pay for his work, and will give a fair day's work for his pay, such a one will give you the most economical service, because that very interest which he displays will excite an interest in each one of the employees, down to the men who carry

the coal up out of the cellar. They each strive to make his department the most favorable. The superintendent institutes a system of reports by which every morning he can tell how the duties of each man were performed; not each set of men, but each man. That puts a man upon his mettle, because he wants to have his record clear and good, and so the company reaps the benefit. If you take a slouchy, easy-going superintendent you will spend more money in that department—that is what you call the running expenses —— without getting proper returns, than in any other department I have touched upon. Therefore, I believe in securing the services of a good superintendent and paying him sufficient money to keep him in the service so long as you want him. You cannot get that sort of a man for $1,200 a year.

Now, I take exception to the statement made by Mr. De Camp at the last meeting in New York with regard to the maintenance of his lines. He said something or other—let me refer to this report please ——

Mr. Fosdick: I do not know just what the object of this discussion is on this special subject. But it seems to me we are wandering very widely from the question of steam-power. If it be intended that that question should cover the whole superintendency, it is proper that this discussion should take the form it has. But otherwise, it seems to me, that we should limit it.

Mr. Morrison: That is a short horse, and easily curried. There were two committees, and they were consolidated; one on the equipment of electric light stations, and the other on steam-power. The gentleman who has just spoken was originally on the steam-power committee. Now he is a consolidated man.

Mr. Cooper: Before you go into that matter, may I ask you a few questions? Your frankness in regard to the Baltimore matter and your modesty speak for themselves. You called Mr. McGrath to task, somewhat ——

Mr. Morrison: I object to that at the start. I will not allow that sort of language to go on record against me. I am not calling any gentleman to task.

Mr. Cooper: I will simply say you criticised in regard to what went before the Convention as to dollars and cents. I think it interests the Convention as much to know how much it cost in dollars and cents as in pounds of coal. In regard to the carbon question, which you went into very nicely a little while ago, we have not found out yet what your winter carbons cost you—those you are using at present.

Mr. Morrison: $12.50 a thousand.

Mr. Cooper: Thank you. And we have no doubt about your being able to switch over. I was a little in doubt about that darkening. I suppose that was caused by the switching?

Mr. Morrison: That is it, sir.

Mr. Cooper: Another doubt is in regard to the Jarvis Engineering Company. A gentleman connected with your company said they tried some retort furnaces, which, as I understand, they did away with. Now, if the Jarvis setting had been so much superior, why did you go to the plain setting?

Mr. Morrison: The question of expense entered very largely into it, and we have an economical board. If I had all the say I would take them out immediately. Now, I am not going into that question. I always try to be guided by the feeling of the majority. I will not go into your question at all, Mr. De Camp. I will just touch one thing, which Mr. Cooper has been kind enough to bring up. Mr. McGrath has given you the expense by dollars. He says it does not make any difference whether it costs $1.50 or $10 for the coal. He does not mean by that that the company pays no attention to the cost per ton, but so far as their estimates are concerned, they take it on the dollar basis.

Mr. Cooper: It is the best results, as I understand it. He may get the best results from a five dollar coal and not from a dollar and a-half coal.

Mr. McGrath: The idea I wished to convey is that we do not carry into account the number of carbons that we use or the number of pounds of coal we burn. We put that in dollars and cents. If we can get more electricity or more carbon out of a ton of coal that we

pay $5 a ton for than out of a coal we pay $3 a ton for, we will use the $5 coal. It would be no use to give you as a basis what we pay for coal in New York. That would not govern you in any other place. I do not see that the cost of coal in the city of New York can have anything to do with what Mr. Morrison pays for his Consolidated coal in Baltimore. It is what electric light can be produced for; not what the coal costs that will produce electric light as compared with one place or with another.

Mr. Morrison: I will return to Mr. Cooper's case. He says Mr. McGrath gave his estimates in dollars and not in pounds. That is not exactly the statement of the case. I gave the number of pounds of coal consumed and the cost of it. I have given you all the information. A man may use some different sort of fuel which is peculiar to his locality, but if you give it in pounds then you know what the coal costs you in your locality. The question of dollars does not give you that idea at all. I think I know what Mr. McGrath is driving at—that, in the one case, a station may be equipped with scientific gentlemen in the engine-room who can get more out of a pound of coal than they can in another station. Therefore, if the cost of that coal is greater in one station than in another it might be overbalanced by the greater degree of skill in the high-priced station than in the low-priced. But, in our case, we conceive that we have as skilled men in our engine-room and boiler-room as there are in the country. We have this additional advantage of using the Jarvis furnace; the additional cheapness of this low-grade fuel, so that in giving you information upon which you can base any estimates, I think it is essential you should not only know how many dollars it costs you per hundred lights, but know what kind of fuel, under what circumstances you obtained it, and what it costs per ton. I can conceive of a condition of things when it would not be wise for a subordinate in a company to give that information, but still that does not alter the fact, and I mean no reflection whatever on any statement Mr. McGrath has made. I have simply

stepped on this floor to give the Convention information, from my standpoint, which they have not been able to obtain.

Mr. Weeks: I agree with Mr. Fosdick, that this discussion is foreign to the matter in hand. We have a committee appointed to report on operating expenses, and all this discussion should have come up under that topic. The two committees combined were to consider the mechanical and electrical appliances of arc light stations and the steam-power. Therefore, I think that all this talk about the cost of running various departments is out of order.

Mr. De Camp: It is not exactly on this subject—but I desire to speak of a matter as a member of the committee of which Mr. Weeks is chairman. I was talking with him this morning about the committee on operating expenses and general management, on which this discussion here has touched, and of a form of record which can be used for the managers of a company reporting to their board. I find that where I am attempting to exchange with some of the companies, their reports come to me in such an entirely different shape from what I am in the habit of using that I cannot make anything out of them. Now, I have a form of report which I think is a pretty good one. It might be improved upon ——

Mr. Weeks: I rise to a point of order. I agree with Mr. De Camp exactly in this matter. The consultation we had is all proper, and I want it brought out in all its details, but this is not the proper time to bring it up.

Mr. De Camp: Then I will put my point without an explanation. I would like to have the sense of the meeting as to a uniform report. Now, I do not want to go into the labor of getting up that——

The President: The gentleman will please come to order. He is not confining himself to the subject in hand.

Mr. Kerr: I feel very much interested in this subject. I am interested in the Corliss engine, and also in the electric lighting business. Now, I am on all

three sides of the thing. Though, I will say that all my experience, and all my labor for years in connection with high-speed engines, make me naturally incline to them, though interested financially in the others. I was very glad to hear so much said in the early part of this discussion about the different classes of engines. I think if we could get rid of the words high-speed and low-speed we would come a great deal nearer to the question. Low-speed is always associated with very nearly single large powers, and fast-speed with subdivision. Mr. McGrath has a subdivided power-station, and uses low-speed engines. People get an idea that low-speed engines are to be single large engines. We know that successful stations are put up with low-speed engines. We also know that high-speed engines are used in stations that are successful. It goes to show that the thing can be successfully done by both these methods. Now, I believe it behooves each man to find out, according to his conditions and his situation, what he ought to have in his station. I know of a single large Corliss engine that I would like to sell a man if he would be willing to buy it; but I know that that station would have about as poor a record if it used that sort of a plant as it could well have. Their conditions are not suited to it. There are other cases in which people having a number of small engines, the conditions would be much improved if they would put in larger engines of the same kind. What I wish to say here particularly is, that when a man speaks of the expense of a station he is operating, it should be taken with a degree of allowance; because, what may be just the thing for one station may not be the thing for another. These things can be charted out in a practical way, so as to enable you to arrive at a result of something like ten or fifteen per cent. of the sizes of engines; that is, where a station is to be remodeled. Starting a new station you cannot always get it so close.

In relation to this matter of economy, I am very glad Mr. Morrison said what he did about trying to get down to something like facts. I have before stated, at other meetings, what I am very glad to repeat here: Any

one who has conducted any considerable amount of experimenting has found out that a man's ability to experiment is rather poor. Even the best men do not make a very good experiment. Now the liability to err in experiments is so great that I doubt very much if more than one-half of all the experiments made amount to anything. The result is, that if any man has anything so important as an electric lighting station, it is very necessary that the greatest care be used to know the results, so that you not only do not deceive others, but do not deceive yourselves. Take, for instance, the engine business. We are selling engines constantly, and get all kinds of reports of them. We have a man running an engine who declares that he is using steam in that engine, and then conducts it up into a mill, and uses less coal in his boilers than when he does not heat the mill. Now, of course, he is mistaken. There are other men who think they are using steam extravagantly when they really are not. A man always declares, and it is natural, that he is right. Now, I believe that there is too much experimenting done on the principle of the Indian who, having heard that feathers were soft, placed one on a rock and lay down on it, and found it was not soft. I believe, from what Mr. Morrison said, that there is some *prima facie* evidence that his company has gone into it carefully. I think these gentlemen from New York and Philadelphia have gone into their experiments to determine the cost very carefully, and they have given us those results. That cost question brings too many elements in, so that we cannot isolate the different things. You can imagine this condition. Suppose Mr. McGrath gets a very good result from certain kinds of engines and boilers. It may be he is getting it chiefly because his engines are good. Some man may go there, however, and not like the engines, but he may like the boilers. The boilers may be bad. He may get boilers of that sort. He may hear of another station where the results are very good. He may like the engines, and the engines may be bad. He may compound the two, and have a bad result, and yet the other two stations

be both getting good results. That is an illustration of the fallacy that can be brought about by going by records that do not isolate different things. I have seen, in engineering, where these mistakes have cost money. I, therefore, would like to put in just a word in passing that, at our subsequent meetings, we be prepared to give the results of some experiment. We can, meanwhile, have experiments made which shall be accurate, and, in the ordinary terms, if possible, of coal per horse-power, or per lamp, the water evaporated by boilers and consumed by engines, and some of the figures which go into these ordinary units of measurement, which are generally adopted in all printed matter. I would like also to see parties give attention to the individual requirements of their case, which case is not like the other man's case. When we do that I believe that the question of high-speed and low-speed and boilers will get along in a better way. I think there is room for that yet, and they all have their place. I would be very glad to see the Association look in this direction, so that our subsequent discussions on these questions may be bordered with figures that will go on record, and be something which we can study.

MR. LINNELL: I would like to suggest one point to the consideration of the Convention, and that is this: Our figures, so far as have been given in relation to the cost of fuel for running electric lights, have been, as I understand it, entirely as to the cost of fuel per light for a given time. It seems to me that this matter of electric lighting is getting to be so divided that the amount of coal used per light is very indefinite, and really means nothing. And there is another point: I think that each company is using its own instruments for measurement. I do not think there has ever been any standard adopted by which the size of the light, which, to a certain extent, governs the amount of fuel used, has ever been determined. Now, I think, there are two points which would be of great interest to the Association: In the first place, the Association should establish a standard for determining the different

characteristics of the different lights, and then, if possible, get at the data regarding the amount of fuel used per horse-power, and from that to the amount of light of each kind, or of each system.

MR. FOSDICK: The last time I spoke I spoke officially. Now, I speak in the private capacity of an engine builder. The discussion so far has been almost exclusively confined to large stations, such as New York, Baltimore and Philadelphia, where there is occasion to use a large amount of power, and where the question of subdivision is taken into account, because there are several large engines. I suppose the majority of those present here represent smaller stations, where, perhaps, there is less than 100 horse-power used. Now, it seems to me, that it is well for us to discuss the question as to high-speed and low-speed *per se;* that is, if we are to put in a 50 horse-power engine for a 50 light lamp, which shall we put in? I wish to be distinctly understood. I mean high rotatory speed, not high piston speed. I undertake to say that a low-speed engine is more economical to use than a single high-speed engine of the same quality. I have in mind a case in point. We put in a 12x24 engine to run an electric light machine, where six months later a high-speed engine was put in, and found so costly in the use of fuel that it was replaced by a second one 12x24, at 125 revolutions, with a saving of 300 pounds of coal during the night's run. This fact can be substantiated by a gentleman in this room who belongs to that station. These are figures that I am ready to give to any man who wishes to get them. I have a case in mind where a high-speed engine is used in a station in which, taking into account the number of lights, the number of hours, and the number of days run, by actual comparison, there has been more than 50 per cent. more fuel used in the high-speed than in the low-speed station. Now, I would like to hear this question of individual comparison between high and low-speed engines discussed. I do believe there are certain elements entering into high-speed engines which prevent the close economy entering into lower ones. I believe also what

has been already said here in regard to the little liability of putting larger engines in. We have in many cases two or three engines running in electric light stations, and no one of them has ever stopped for any purpose. So it seems to me that the question of economy in the larger engines more than offsets any possibility of danger.

I agree with the President, that the care of the engineer has a great deal to do with this question, both in high-speed and in low-speed. The economy is in favor of the low-speed engines for various reasons, which engineers fully understand. In Fall River they found that these immense engines make very slow engines; that there is a cessation of movement of the fly-wheel from the commencement to the end of the stroke, consequently that at a speed of 50 or less revolutions the variation is slightly perceptible.

Mr. Smith, of Jamestown: My experience may be of interest to the Convention, though entirely of a different class from what we have just heard. It has been acquired among the engines in the cotton mills of Lancashire. We are running the plant in Jamestown from the mill engine. The engine starts at half-past six to run the mill, and runs to half-past twelve to run the electric light plant. My opinion is, that Mr. Fosdick, and Mr. De Camp, and Mr. Evans here, are entirely correct as regards the economy of large engines, and I will try to show why. These engineering gentlemen have not given us any reasons why a small engine, with high rotatory speed, is less economical than a larger engine with lower speed. In the first place, you must stop the piston. Another thing is this: to reach a high-speed economically, you must have a high initial pressure, and then, with your American system, you have reduced the steam down to a mere nothing in order to obtain economy. The consequence is, you have the temperature of your cylinder at the beginning of the stroke at the temperature of the steam. You are heating and cooling all the time, and your boiler has to pay for it.

In America you are altogether behind in regard to economy of engines. Perhaps you may think this is the bigoted opinion of an Englishman. Now, you cannot find in a cotton mill in Lancashire a single high-pressure non-condensing engine. You Americans are full of very extravagant habits. You have not found out yet that high-pressure and non-condensing are not economical. How many people are there using condensing engines? Very few, indeed. I say you are all wrong. My engine is an English engine. It is sixteen inches diameter in the high-pressure cylinder, thirty-two inches in the low-pressure cylinder, and has a condenser besides. You could not give a high-pressure non-condensing engine to a man running a cotton mill in England. The only engine that finds any favor in England now is the compound condensing engine. My engine is a compound condensing engine. We run at seventy-two revolutions a minute. As a proof that we get the steadiest light possible, we are running the incandescent light on the same circuit with the arc light, and there is not the slightest perceptible flickering. That is an economical engine. You cannot get economy with a single cylinder engine, or a high-pressure engine. It is all nonsense about warming the mill. You do not want to warm the mill in summer. Then again, in the equipment of engines you do not manifest economy. The reason for this is, that in America you have such a good trade and good profits that you can afford to be extravagant. Some of the gentlemen here are connected with cotton mills. Now, if you gave a cotton mill proprietor in England a high-speed engine, he would lock up his mill in six months.

Mr. Cooper: There are circumstances, as one of the gentlemen has said, that alter cases. One of the objections to using condensing engines in our cities is the cost of water. It would cost us more for water than fuel.

Mr. Smith: I recognize that in many cases it cannot be done. Any gentleman, located on the banks of a stream where he can get water for nothing, will find economy in using the condensing engine. We are run-

ning our engine from six o'clock at night, with a 145 light Brush machine. We have about 50 horse-power, and can run five or six hours with about 1,000 pounds of coal. The maker of our engine guarantees that it shall not cost more than $5 a year for fuel, and the coal bill shall not exceed $1,500 a year for 300 horse-power. The price of coal is about the same there as here, slack coal costing about seven shillings a ton.

MR. KERR: I am very glad to hear the gentleman mention compound engines, because we all agree that compound condensing is the proper way to build an engine, when, in the first place, you can sell the engine, and, in the next place, you can get the water for condensation. I wish to take exception, however, to the point which he makes regarding the difference in cylinder temperatures. As I understand his statement, a fast running engine would consume more steam, because a greater number of times per minute is the cylinder temperature changed between initial and terminal temperatures. I wish to say the flow of heat is proportional to two things—the pressure and the time. The length of the exposure of steam to the surface is so decreased that it brings out practically the same results. No tests have ever yet been made that would demonstrate any perceptible difference between the two, and when the thing is immeasurable we can consider it practically law. We know that compounding produces a very great effect upon the differences in cylinder temperature, and that is one of the objections to compounding, even if we leave out the question of condensation.

MR. SMITH: Of course, in a high-speed engine you get over the difficulty to a greater extent than you do in a low-speed engine. Still, the fact is there all the same. In my engine I have about 180 horse-power. The steam in our low-pressure is always below the line.

MR. KERR: Consequently your engine would not be a fair one to measure. I have no doubt you have a fine operating plant, but that is not a typical plant of this country.

MR. SMITH: When I came here the people put in an American engine. I estimated that the coal used in

this high-speed engine would in twelve months cost me as much as the difference in the cost of the engine.

Mr. Kerr: What is the economy of the engine in pounds of coal per hour?

Mr. Smith: Two pounds and a-half slack coal.

Mr. Upton: We have an Armington & Sims engine, $16\frac{1}{2}$x24, which is doing a duty of $2\frac{38}{100}$ pounds of anthracite coal per horse-power.

The President: Mr. E. T. Lynch, superintendent of the United States Electric Lighting Company of New York, asks me to make this statement for him: "We have just put in a 500 horse-power condensing engine. The engine is known as the Watts-Campbell-Corliss engine. We get our water from Twenty-ninth street at the East River. The consumption of fuel in that engine is $1\frac{7}{8}$ pounds of pea coal per horse-power per hour."

Mr. De Camp: I never heard any one question the economy of the condensing engine. We have, in the first place, to locate our plant where we can get a space to put it, and at a price within reason. We might have gone but a short distance farther, perhaps a quarter of a mile, and struck the Schuylkill River, but we would have had to pay about four times as much for a piece of property on which to locate our plant. Even where we are, the question of condensing engines was discussed at the start. I think we calculated it would cost about seven or eight thousand dollars a year for water-rent. Of course, we could not stand that.

Mr. Weeks: It is not my province, Mr. President, to speak on this question; but it seems to me some points have been overlooked or omitted. One of the gentlemen who championed the large engine said that no reasons had been given why the small, or high-speed, engine should be used. I will not go into the mechanical technicalities of this matter at all, but will just suggest a few considerations that are apparent. With a large engine, for instance a 250 horse-power, running 300 lights, one of the first objections would be, that in case of any disaster, the failure of any one of the hundreds of appliances that go to make up that 300-light lamp,

the 300 lights would be out unless you had a reserve equal to that number, or a duplicate of that part of the plant. But with a high-speed engine you, of course, do not have so much at stake. In case of stoppage, there is not so much dissatisfaction. These are two of the chief reasons why the high-speed engines have come into favor.

As regards economy, I think there is no question at all but that the balance is in favor of the large engine. We have demonstrated that matter in our plant. We put in a 150 horse-power Corliss engine, and find that we get better results than we do out of smaller engines, which we have subsequently put in.

MR. FOSDICK: I would like to ask the gentleman if he is not confounding subdivision with high-speed? There is a broad distinction between putting in large engines and small engines and putting in high-speed engines.

MR. WEEKS: I did not mean to confound them, though possibly it had that appearance. But another point that has not been mentioned is the setting of the machine; whether it should be with a horizontal belt, or a belt at an angle with the horizontal or perpendicular plane. In almost all of the plants that I have visited there is a horizontal belt, and so set with a quarter-box that the strain would ride against the joint in the box of the journal. Now, as time goes on, there will be wear and consequent interference between the armature and the field. I have known of two or three such cases. Therefore, I think that should be overcome by making suitable boxes, or by setting the machine either above or below the pulley.

There are many other things that ought to be discussed under these two topics—appliances, etc. Mr. Fosdick suggested that these are matters for the local engineers to decide. I think not. I think they ought to be discussed by the Convention. For instance, a great many people make a mistake in putting in too small steam pipes. They do not have sufficient heaters. There is a great deal of economy in a heater, and, I think that the proper type of heater, the proper size

of steam pipe, the proper setting of the boiler, and a thousand and one things that pertain to these two subjects ought to be discussed.

Mr. Evans: In your experience, Mr. Weeks, with the high-speed engines against the long-stroke engines, has it not occurred to you that there have been more breakdowns, more stoppages, with the small than the large engines?

Mr. Weeks: Our experience so far has not been extensive enough to make any comparison. The high-speed engines have but recently been put in.

The President: The gentleman is in favor of a large steam pipe, I take it.

Mr. Kerr: I had in mind to say something of a different nature, but in the same direction; that is, I hope that at some subsequent meeting the appurtenances of engines and boilers will be brought up as a subject, and then the discussion limited absolutely to them—such as steam pipes, foundation, and two or three other things of that sort, which are worthy of one hour's attention by this Association, so long as we do not talk of anything else during that time.

But while I am up I want to make just one or two statements as an engine man, because I think the discussion, perhaps, to the minds of those who are not thinking about engines all the time, may be a little mixed. A large engine of any kind is more economical than a small engine of the same kind. When you get small engines there is more difference in the circumstances under which they are running than in the types of engines themselves. A four, a two, and a one-valve small engine will run very close in regard to economy. When you get to large engines you can put appliances on which cannot be put on our small single-valve engines. Therefore, I think that these things should be carefully isolated from each other, so as not to confound them. I know from personal knowledge that when we get to about 75 horse-power it does not make any difference what kind of engine we use for economy.

Mr. De Camp: May I bring up the question I tried to bring up before?

The President: Yes, if there is no further discussion on this point.

Prof. Sweet: I would like to help the gentleman out. If engines are governed so close as I see some, there is difficulty in using the ordinary clutch. Now, as a remedy, if the engines do not govern themselves close enough, put counters or indicators on the two engines, start up the engine that is running the light, until it comes up to the speed of the other engine; then pull on the other clutch the minute the introduced engine takes the load and the other is shut off. One will take the load. Pull out the clutch and let it go on. It seems to me there is no trouble at all if you come back to the original clutch.

Mr. De Camp: I know where there are several clutches used in mills that are working very satisfactorily with a shaft-speed of about 150, and a power of 50 or 75 horse. But in our case we have a shaft-speed of 305. Now, we want to be absolutely certain. The load is so heavy, and the slip of the clutch is sufficient to affect our lights.

Prof. Sweet: If you catch it at the time it comes to the spot you need not keep it there at all. As I say, if one engine is running one turn a minute faster than the other your speed would be running two or three turns a minute. If your shaft is at rest and your engine is only making three turns a minute you need have no hesitancy in throwing your clutch in.

Mr. Kerr: I know where it is done.

Mr. Sims: I am interested in a business whose sole manufacture is the building of engines, both quick-acting and medium-speed. We have built about 1,700, 600 of which have been bought by the different electric light companies of the country. We have built many large engines of low-speed for mill purposes, and many have been bought for the different electric light companies, of which we have sold about 2,500 horse-power; whereas, of our quick-acting engines, you have bought about 25,000. Why do you buy them? It is for you to answer. I mention that as I am interested, as I stated, in the manufacture of engines.

The consumption of coal is a very important factor. As an illustration, we placed three engines in an electric light station, which were sold by the electric agents for 60 horse-power each, and we only marked them 35. We have four 50 horse-power engines that are running at 80 horse-power each, and I am told that they consume eight pounds of coal to the horse-power. I do not care if they consume eighty. I have nothing to do with that. I am not interested in it. But with eighty pounds pressure, with an indicated horse-power of 50, we will guarantee that the engines will run on $2\frac{3}{10}$ pounds of coal. I obtained that after much hard labor, firing the furnaces without any assistance, and reducing the consumption of coal from $5\frac{1}{2}$ pounds to that figure, and later to $2\frac{9}{10}$. I care nothing about that. As to the extravagant consumption of coal in a case in Norfolk, Va., mentioned by Mr. Evans, I do not know how much the engine was doing; but we do have this satisfaction occasionally, that, if by good fortune, the engineer puts the steam up from 100 to 130, and puts on the light, it will burn your dynamo out.

The point made in regard to the engineer is a good one. I appreciate it, and am very glad that you stated it. Many of our troubles, and the troubles of the electric light people, come from incompetent men. Your business is one that is coming quickly before the country. Men have not been educated to it, and you have been obliged to accept such labor as was offered to you. Labor is a commodity in the market, and has its value; and, I must say here in behalf of Mr. McGrath, that he appreciates labor; he pays good wages; his station is well managed; and when he speaks of the economy of his station you gentlemen must take that into consideration, and not compare it with one or two small engines that are placed in the wilderness. You all thoroughly understand that a large engine is the most economical. That is a self-evident fact, and it is not necessary for me to enter into an explanation.

In regard to the life of a high-speed engine, we placed three in the Edison central-station in Pearl street, New

York. They were 14½ in diameter by 13 stroke, and to run 350 revolutions. One of them ran 16 days for 17½ consecutive hours, making 8,500,000 revolutions without stopping; and, if a locomotive with a six-foot driving-wheel had made that run it would have made the circumference of the earth 1¼ times. These engines have been in use three years and three months at eleven hours a day, and they have made 272,000,000 revolutions. The expenses upon the three engines for the three years and three months have been $41—renewal of a few small steel pins.

In speaking of large engines, from a pecuniary standpoint, we prefer to build the low-speed, rather than the quick-acting. As it is not for us to say what you shall have, we are only too glad to fill any orders we may receive.

In regard to the matter of belts and boxes, I desire to say, in answer to Mr. Weeks, that it is a matter of mere mechanical construction whether you belt up vertically or at an angle of 45°. It makes no difference. The construction of the engine should provide for that, let the belt be what it may.

It is a fact that the electric light does call for a quick-acting engine. It must be quick-acting, because in the city of New York, and in your city, and in others, real estate is a consideration. I have understood that down town the difference in the price between the area required by our engines and those of the low-speed was $72,000. That is a very important item.

The point raised by the gentleman here upon my right—Mr. Linnell—to arrive at the consumption of coal per horse-power per hour, and not the cost of the lamp, was a very excellent one.

Now, one word in regard to engines. I know of two Yankees who sent two engines to the House of Commons in London, placed them in connection with the electric light, and they have been running four years. We have 40 engines in the city of London, 16 in Milan, 15 in the Italian navy, 4 in Genoa, 4 in Amsterdam, 6 in Berlin, about 18 in Santiago, Chili, and, in fact, our engines are distributed nearly over the whole world.

I am sorry to say that your stockholders throughout the country are much disappointed in the construction of many of your stations. I have been fortunate enough to remove several large engines and put ours in their place, with better results. We were called on to furnish a pair of large engines, the diameter of the pulley being specified, and I asked how they arrived at that conclusion. They said the circumference of the wheel must run one mile a minute. I said what has that to do with the engine? They said: "That is none of your business." We built it under protest. They paid us $6,000 for repairs. They afterwards made independent engines of them at an additional expense of $2,500. Now, it did run a mile a minute, but those people got very tired of it in a short time, and we were very much disappointed in the order.

MR. FOSDICK: Did the gentleman say he would guarantee his engine of 50 horse-power to run on $2\frac{3}{10}$ pounds of coal?

MR. SIMS: $3\frac{2}{10}$ I should have said.

MR. MCGRATH: I would like to ask the gentleman what quality of coal he used?

MR. SIMS: Anthracite coal. I would say in making that guarantee, that I propose to take care of the furnace. I will shovel the coal.

MR. LINNELL: I think, Mr. Chairman, that in buying an engine of that character it is possible that Mr. Sims may not care to stay and fire the boilers. I would like to make a statement here, that we have been having considerable experience in running engines of different kinds throughout the country. We are a young company, but we have put in quite a number of plants and used a number of different kinds of engines. We have never used anything but the ordinary settings. We have bought the best boilers we could purchase, and have used generally a mixture of anthracite screenings with soft coal mixed in the proportion of two of screenings to one of soft coal. We have been running with a trifle less than three pounds of that mixture per light.

Mr. Kerr: We recently made a test on a 12x11 engine, running, I think, 320 revolutions, which was put in under a guarantee of $3\frac{75}{100}$ pounds of coal, and obtained an economy of $3\frac{23}{100}$. These tests can be repeated at any time. Such tests are made, as Mr. Sims has said, where your own men are firing the boilers, and when you are careful to see that there is no waste. We cannot go out in ordinary service and give that economy by the week, because people will not be as careful every day as you are when you test.

Regarding the question of the durability of high-speed engines, I would like to add to those facts some of our experience. We are peculiarly situated. We have a large engine business, having about fifteen engines running, the repairs of which are made almost entirely by duplicate parts, and, consequently, we hear of all breakages. My private opinion of the high-speed engine business is drawn from about four years experience, during which time we have put out a very large number of engines which have been of a more or less experimental form. We have been more than pleased with the small amount of repairs, taking them throughout. We have had a good many repairs to make, but not as many as we expected to have. We notice also that we have many more repairs to make from getting improper materials, while learning how to use the right kind, than from any other cause. I think we have had more difficulty from not getting the right kind of metal to cast in the connecting rods. We have used malleable iron rods, cast-steel rods, and other things. That is a thing which is not, in any way, due to high-speed.

As to the question of some long runs, Lombard, Ayres & Co. have an 11x11 engine, 65 horse-power, which runs a large blower, requiring 50 or 60 horse-power to drive it. That engine was started in November, 1884, and until the first part of July, 1885, the engine was never shut down except to change its belts. At that time it was shut down in order to replace the connecting rod, which had cracked. From that time on until the following November the engine was never stopped.

The Secretary made an announcement as to a visit to the electrical railway.

MR. H. W. POPE: I shall probably be called away this afternoon, and there are some few matters here I have been requested to introduce. I move as an amendment to Article 3 of the Constitution of this Association the following:

Strike out all after the word "Executive Committee," and add "And shall be entitled to all the privileges of the Association, but shall not be eligible to office or entitled to vote. Such associate members may be appointed to serve upon committees, in the judgment of the Executive Committee."

The motion was seconded.

MR. DE CAMP: I think that is the subject that created so much discussion at our last meeting.

The amendment was adopted.

MR. H. W. POPE: The Telephone Association, of which I have been a member for a number of years, at their Convention in 1884, formed a very intelligent and competent committee to take up the subject of wire gauge. This committee, of which Mr. Sargent, of Brooklyn, was chairman, made a report, and this report recommended that the English standard gauge, which was regulated by an act of Parliament to take effect by the first of March, 1884, be adopted by that association. They have sent a communication to this Convention, addressed to the President, which, with your permission, I will read:

"*J. F. Morrison, Esq., President of the*
National Electric Light Association:

"DEAR SIR: I have the honor to notify you of the adoption by this association, at its annual meeting in September last, of the standard wire gauge, which is now recognized as the official gauge by the English Government. At the same meeting I, as Secretary, was directed to correspond with other electrical associations with the view of inducing them to take similar action, and thus in time do away with the confusion resulting from the multiplicity of gauges now in use. It is believed that should a common standard gauge be adopted by the electrical fraternity, a concerted effort will induce Congress to legalize the same in

the enforcement of contracts. There can be little difference of opinion as to the desirability of such a result. The subject has been agitated in our association for some time, and as a result a committee on standard wire gauge was appointed at the Philadelphia meeting in 1884. This committee obtained a great amount of information, secured the opinions of many electricians and manufacturers, and embodied the same in a report made to our meeting in 1885, as a result of their investigations, recommending the adoption of what is known as the new English standard gauge as the official gauge of the National Telephone Exchange Association. This recommendation was adopted. The report of the committee and the discussion thereon will be found in the report. I send you by this mail an advance copy of the same and also several copies of the table of dimensions, resistances, etc. I trust you will bring this matter before the association."

Now, Mr. President, I offer the following resolution:

Resolved, That the new English Board of Trade standard wire gauge, adopted by the National Telephone Exchange Association, September 8, 1884, be and the same is hereby adopted as the official gauge of this Association.

Resolved, That the President take such steps as in his judgment may seem necessary, through a conference with the Telephone Association or other associations interested, toward inducing Congress to legalize the same in the enforcement of contracts.

Resolved, That 1,000 copies of said standard gauge be printed for distribution by this Association.

The resolution was seconded by Mr. Cooper.

MR. H. W. POPE: It is hardly necessary to discuss this matter. It is a subject with which we are all pretty familiar. There are any number of gauges and almost everybody knows the difficulty experienced, not only in the electric light business, but in the telephone business. It is very essential for this Association to do what it can to adopt a uniform gauge, and, therefore, I hope that this resolution will prevail.

MR. RALPH W. POPE: I would like to inquire whether the gauge runs uniformly, so that the larger sized wires used by electric light companies will also be uniform, so that the same uncertainty will not prevail that does now?

MR. H. W. POPE: The largest size they have here is No. 4.0.

Mr. De Camp: That, I think, is a very important thing, because the confusion of sizes of wire is a very great annoyance.

Dr. Moses: I would like to ask Mr. Pope whether there has been any very decided objection to the French system?

Mr. H. W. Pope: I would say for the information of the gentleman that in looking over the discussions before the telephone convention, there were many recommendations as to the diameter of the wire. They received replies from fifteen different parties who are especially interested—manufacturers, for instance—and seven of those replies favored the English, two the American gauge, and six had no preference. I have not been able to give this subject a great deal of attention, because it was only brought to my notice yesterday.

Mr. Cooper: As an amendment to that resolution, I would move that the Chair appoint a committee of three with authority to act in the interests of the Electric Light Association, and report such action at the next session.

The motion was seconded.

Mr. Cooper: That is, they can adopt it if they think it is for the benefit of the Association.

Mr. Smith: The difficulty now is in the multiplicity of gauges. Now, you have Brown & Sharp's, Stubbs', the American, and the new English gauge, and things are so mixed up a man cannot tell what he is doing.

The amendment was adopted.

The President: The question now occurs on the original resolution, as amended.

The original resolution, as amended, was adopted.

The chair appointed Mr. Charles Cooper, Mr. Ralph W. Pope and Dr. Otto Moses as the committee.

Mr. H. W. Pope: I was appointed chairman of a committee yesterday on the matter of electric light rates. After a discussion of the subject we decided that, in view of the fact that we could not get any record that could be put in the minutes of this meeting, it was not necessary to report, if the Association

would give this committee, or some other committee, power to act after the meeting of this Convention. The intention is to get as nearly a correct list of rates and general statistical information of the various electric light companies as possible.

Mr. Weeks: I move you that the committee be made a standing committee, and report at our next Convention, six months hence.

The motion was carried.

Mr. De Camp: I have a paper in my hand that was adopted by the Philadelphia Company in making their reports, showing the cost of their operations on these particular items. I think that we can get a great deal of valuable information if every company would adopt the same or some other form. That would entail a great deal of labor, which I would be perfectly willing to devote to the subject if I felt that I would be supported by the members of this Association—*i. e.*, if there is a feeling on the part of the members of the Association that they will co-operate in this matter. If we cannot have the co-operation of the majority of the members I do not propose to undertake it.

The Secretary: The President appoints the following committee on transportation:

For the East—J. F. Noonan, Paterson, New Jersey; Henry D. Stanley, Bridgeport, Connecticut; James English, New Haven, Connecticut.

For the South—L. M. Fishback, St. Louis, Missouri; Mr. Yarborough, Nashville, Tennessee.

For the West—George Wadsworth, Cleveland, Ohio; S. A. Duncan, Pittsburg, Pennsylvania.

The President: Before a motion to adjourn is made I want to state to the Convention that the Secretary, Mr. Rhinehart, has mailed to the insurance companies of Baltimore an invitation to be present to-morrow evening at 4 o'clock, when Mr. Woodbury will present his paper on "Electric Lighting and Insurance."

I desire to state that Dr. Moses has brought with him to Baltimore an incandescent lamp which, in my judgment, it will be very advantageous to the electric lighting men present to examine carefully. I would

be glad, before the Convention adjourns, if Dr. Moses can be induced to bring the lamp into the Convention and make some explanation in regard to it.

Mr. Cooper: I think it would be well to appoint a committee on the question that Mr. De Camp brought up about some form of a general report to be adopted by all the companies.

The President: Mr. De Camp asked for a delay of that matter until the following afternoon.

Mr. Weeks: That properly belongs to the Committee on "Operating Expenses."

The President: The first paper taken up upon the re-assembling of this Association will be the matter of "Underground Wires." It will be a long session, and I hope the gentleman who makes the motion to adjourn will make the recess long enough to enable the members to recuperate.

Mr. Ralph W. Pope: I have several letters here which I would like to dispose of.

A Member: I move that they be received and filed.

The President: Perhaps the gentlemen understand what the letters are. They are replies to invitations to honorary membership sent to prominent gentlemen in Europe and elsewhere. If the gentleman reads the names of the writers, whether it be an acceptance or rejection, they can go in to the report.

Mr. R. W. Pope: They all accept the honor. They are Sylvanus B. Thompson, London; R. E. Crampton, London; Z. T. Gramme, Paris; J. Hopkinson, London; Professor George Forbes, London; Joseph Wilson Swan, Launceston, England; John T. Sprague, Burlington, and Edouard Hospitattier, of *L'Electricien*, Paris.

The Convention then adjourned until 4 o'clock in the afternoon.

AFTERNOON SESSION.

The Convention was called to order at 4 P.M., Mr. H. M. Cleveland, Vice-president, in the chair.

THE CHAIRMAN: The Secretary has a telegram, which I would like him to read.

The Secretary read the following telegram:

"NEW YORK, February 11, 1886.

"*J. F. Morrison, President, and others:*

"Please accept sincere thanks for your invitation to be with you to-day or to-morrow. My warmest sympathies are with you in any good work that will serve as a genuine benefit in developing the business of electric illuminating, and strengthening the financial interests of the local companies. As a commercial business, electric illumination is fully established, and only requires honest, conservative, and loyal work, coupled with unity of action, to place it upon as solid and enduring a basis as the gas interests of the world have hitherto occupied. I delayed answering this morning, hoping I could manage business engagements so that I could be with you. I found it impossible, and now send you greeting, and hope you will so conduct your deliberation as to realize all the benefits anticipated when the Association was formed. Above all things, avoid rivalry and jealousy in discussing the various systems and methods which are so common among the manufacturing, or so-called parent companies, many of whom seem to act as though local companies are mere servants, and competition by younger and less pretentious concerns a crime. Be sure and officer your Association with your ablest and most earnest men who are loyal to the business. Simply desirous of seeing the survival of the fittest, I am, respectfully, "EDWARD H. GOFF.

"The manager of this company, who is a friend of mine, says if I will add a few more lines he will give me a pass, but I have declined out of sheer consideration for the Convention.

"EDWARD H. GOFF."

MR. COOPER: I happened to hear that part of Mr. Goff's telegram in regard to rivalry, etc. It may sound all right in a telegram, but from my standpoint, as one

of the sub-companies, I must assert that I do not think Mr. Goff's words and his actions agree. All the sub-companies engaged in the electrical business are aware of the fact that he has recently formed ten companies, the majority of which have been organized for fields already occupied by electric lighting sub-companies. I have never had the pleasure of meeting Mr. Goff, but I have had the pleasure of reading several of his communications, and his actions and his words differ very materially. When he comes to Brooklyn we shall be glad to see him.

MR. DE CAMP: I move to amend Article 4, of the Constitution, by striking out after the word "President" the word "three" and inserting the word "two."

The amendment was adopted.

MR. DE CAMP: Now, Mr. Chairman, I move that a committee of three be appointed to nominate officers for the ensuing year.

The motion was carried.

MR. COOPER: I have a report from the committee on standard gauge:

Resolved, That the new standard English gauge, as officially adopted by the National Telephone Exchange Association, be and is hereby approved by the National Electric Light Association, for the purpose of insuring uniformity in the mutual understanding of orders between manufacturers, dealers, and consumers of wires for electrical purposes.

Resolved, That the members of this Association engaged in the manufacture and sale of wires be requested to incorporate in their catalogues and price-lists the stipulation that the standard gauge approved by the above associations be understood as applying to all orders, unless otherwise specified either in quoting the prices or shipments.

The report of the committee was accepted, and the resolutions adopted.

MR. H. W. POPE: I wish to offer the following resolution:

Resolved, That the committee on standard guage be continued, with instructions to confer with other associations similarly interested, with a view to the legalizing by Congress of such standard gauge for guidance in the preparation and enforcement of contracts.

The resolution was adopted.

The Chairman: The Chair will appoint as a nominating committee Mr. De Camp, of Philadelphia; Mr. Gilbert, of New Haven, and Mr. King, of Minneapolis.

Mr. Weeks: I have noticed from time to time that there is considerable doubt as to the proper pronunciation of the word "dynamo." It is variously pronounced dy-namo, dyn-amo and dynam-o. Now, I think it comes within the province of this Association to decide upon that matter. The leading principles of pronunciation are, first, derivation; second, euphony; third, ease of utterance. By derivation this should be pronounced dyn-amo, as it comes from the Greek word *dun-amis*, which means power. So far as euphony is concerned, it makes little difference. But so far as ease of utterance is concerned, it makes a great deal of difference, the majority being in favor of placing the accent on the first syllable. I offer a motion that the pronunciation of that word be established by this Association as dyn-amo, sticking to the Greek.

Dr. Moses: I think the point is very well taken. The Greek word from which that is derived is *dun-amos*, the accent being on the first syllable. So that if we wish by analogy to use the word, approving the derivation from the Greek, we should as nearly as possible adopt the Greek pronunciation. We say dyn-amite, we should say dyn-amo, as it is derived from the same root. I should think we could adopt that, not by direct action on the part of the Convention, but by convention, if you please.

Mr. Cooper: I move as an amendment, that instead of adopting the Greek pronunciation, as we have not many Greeks with us, we adopt the American pronunciation, dy-namo.

Mr. Weeks: I wish to correct Dr. Moses' Greek. I think the word is *dun-amis*.

The amendment was approved and the resolution, as amended, adopted.

The Chairman: Mr. Ralph W. Pope will now open the session of the afternoon with a paper on "Underground Wires."

Mr. R. W. Pope: The six months which have passed since our last meeting, although not productive of material progress in the burial of wires, have at least been instrumental in bringing to the attention of the people generally some of the difficulties which are to be encountered in this work. Having arrived at the conclusion that the important subject of subterranean systems was practically confronting us, either for good or for evil, your committee was represented at all of the public meetings of the New York Commission on Electrical Subways which were held subsequent to its appointment. Over one hundred different plans were presented, out of which a very few were in actual use. As is generally understood, the supposed object of this Commission was either to select, or cause to be devised, what is termed an inclusive system; that is, one which would satisfactorily accommodate the various descriptions of electrical service owned by thirty or more different companies in the city of New York. According to the generally accepted interpretation of the law under which the Commission was appointed, its investigating duties were properly confined to the subject of conduits, through which the various companies are expected to lay such classes of insulated wire as they prefer. Among the vexed questions which continually cropped up, was the inductive effect of the arc lighting wires upon those of the telephone and burglar-alarm systems more especially, although none of the other interests appeared to regard them as desirable neighbors.

Among the proposed plans of providing for arc light wires were those of imbedding them in a solid prism of insulating material, the individual wires being either bare or insulated; running them through small individual ducts or small glass tubes; making them up in cables, using various descriptions of insulation; but more commonly the individual wires were expected to be insulated and covered with a sheathing of lead. In the latter form subterranean arc lighting wires are now and have been in use for a considerable length of time in Chicago and Philadelphia. In practice there appears to be a difference of opinion as to the choice between a solid and a stranded wire. Where a single conductor is used the question is not of great importance, but where several conductors are grouped in a cable, it is necessary that each should be made up of strands in order to secure the requisite flexibility.

For underground work, especially cables, it is of vital importance that the conductivity should be ample and the insulation unquestioned. In both of these particulars it will be found most economical in the end to allow a safe margin. The value of a conductor when once placed in position is sufficient to warrant that no reasonable care or expense should be spared to provide not only against actual damage, but also the annoyance arising from interrupted circuits. It is here that the principal

item of additional expense for underground work is to be incurred; for while wire suitable for ærial use in arc lighting costs but about two cents per foot, the price of insulated wire, which may be safely put under ground, ranges from six to twenty-five cents per foot. Without going into the question of ditches, conduits, poles, insulators, etc., in order to obtain a basis for a proper comparison of prices, we are at once confronted with the stubborn fact that the wire alone will cost at least $300 per mile. The various circumstances which will govern subterranean construction in different cities will materially affect the cost of the work. Where conduits are provided by a company organized for that purpose, a fixed rental will doubtless be charged, and the manner in which the space is utilized, and the number of wires for which accommodation is required, will have a most important bearing upon the cost *pro rata* of each circuit. In Chicago a 2¼-inch duct is rented for $500 per year, which, if required, will permit eight arc light wires to be drawn in, each being five-eighths of an inch in diameter outside. It is evident that in cases where individual companies perform their own construction the proportionate cost of each circuit is considerably reduced as the number of conductors increases. In such cases, also, the company doing its own work may choose its own method, while in dealing with a conduit company it is obvious that the facilities offered must be utilized. We have already pointed out the necessarily increased cost of the wire to be used for this work, and it is obvious to all that, if a conduit be adopted which will permit the use of the lowest-priced wire without endangering either the property or the service, there will be a considerable saving in this particular. To accomplish this desirable result the conduit should be of an insulating material, and of sufficient stability not only to protect the wires from mechanical injury, but to endure the ravages of time and the disintegrating effect peculiar to the soil arising either from natural or artificial conditions.*

While it may be perfectly practicable to insulate arc light wires from the possibility of earth contact under ground, the difficulty and expense of doing so is materially lessened by the use of an insulating conduit. Upon this question there is an honest difference of opinion between different investigators, some of whom confine their attention to the requirements of the particular branch of service in which they are interested. It being the natural tendency of electricity to seek the earth, it appears wise, if compelled to use subterranean wires, to insulate them as effectually as possible at a reasonable expense.

To enter into the merits of the various proposed plans for this character of work, and invite discussion regarding features which would not be based upon the test of actual experience, would be beyond the province of this report, and it is, therefore,

confined to brief details of systems with which many of your members are already familiar.

A conduit of cast-iron is now used in Philadelphia, through which arc lighting wires have been drawn, for a system which has been in operation for over two years. Over 250 lamps are said to be used in connection with it. The conductors used are insulated with India rubber, covered with braid and sheathed with lead, the outside diameter being half an inch. This conduit is built in sections, with shelves inside to accommodate different classes of wires, although used commercially for electric lighting only. No record is presented regarding the regularity of the service, but it is said to have been perfectly satisfactory. Man-holes are placed at the street corners in connection with the conduit, the wires being drawn through by hand, as required. These man-holes are built up of cast iron rings, although in some cases it has been found necessary to construct them largely of brick on account of existing water and gas systems which required a departure from the regular plan. The conduit contains upper longitudinal compartments, to which access may be attained through hand-holes, which are located just beneath the pavement in front of each building. Any wire which is required for service at any building along the route is diverted at the man-hole to one of the upper compartments. With the use of an earth auger, connections are made by boring through from the cellar to the hand-hole and inserting a sufficient length of gas pipe. Considerable difficulty was experienced by the accumulation and explosion of gas which leaked into this conduit, which is now obviated by driving a current of air through it.

The conduit system of Chicago, in which various arc lighting wires have been placed, is made of a special form of asphaltum concrete, originally devised for sewer-pipe, and according to the testimony of civil engineers who have carefully examined it, it is practically indestructible for underground work, although it should be properly protected from the prolonged effect of extreme heat. This material is a good insulator, and it was this qualification which led to its availability for subterranean electrical work. This form of conduit was referred to at your last meeting, and since that time has been introduced in Detroit, where an arc lighting system in connection with it was recently established, which is now in operation. Connections to buildings are made in Chicago by laterals leading from the man-holes at street corners to the vaults under the sidewalks, or areas, as they are called in that city. There are no overhead wires used for electric lighting, neither is there any public street lighting by electricity.

In Washington, where the Government authorities are forcing the electrical companies to place their wires under ground, no inclusive system has been suggested, but each company is

supposed to adopt such a plan as may best suit its requirements. This condition of affairs is liable to arise in cities which are subject to underground enactments, but in which the electrical systems in operation are not sufficiently compact to require a general conduit.

The plan adopted there for arc lighting wires consists of a wooden trough, in which insulated conductors are laid side by side, the wires being separated from each other by the use of bituminous bridges, which are placed about eighteen inches apart. The trough is then completely filled with bitumen, making a solid insulating mass impervious to dampness. With wires of ample conductivity, such a plan is, no doubt, permanent and reliable. The distribution wires are branched out in a similar manner. With a small number of main lines, this operation is comparatively simple and may be readily understood by examining the drawing herewith.

An estimate is appended, giving the cost of a 60-arc light plant arranged in connection with an underground conduit of this character one mile in length.

Your attention has been directed only to such underground work as has been actually accomplished in this country for arc lighting purposes, with a view to the accumulation of general information which may be of benefit in the future extensions in the industry in which you are engaged. The nature of the subject is such that there will necessarily be many conflicting opinions as to the proper course to be pursued, in which you will naturally be guided by a proper regard for safety, reliability, durability, and economy of construction.

ESTIMATE FOR SIXTY LIGHT ARC PLANT WITH UNDERGROUND SYSTEMS.

Building	$ 1,000
Eugine and boiler	2,000
Two dynamos, lamps, etc	10,000
Underground conduit (one mile in length)	4,000
Two mains, four wires, including 60 connections, say	$17,000
On basis of capital, say	$20,000

Expenses of running plant would be:

Labor—1 superintendent	$2 50 per day.
1 trimmer	1 50 per day.
Engine driver	2 50 per day.
75 carbons	1 50 per day.
Coal	3 75 per day.
Sundries	1 00 per day.
	$12 75

If only 50 lights are used, at 40 cents per night each, it will yield a revenue of $20 per night.

A revenue of.....................................	$20 00
Which will have cost..................................	12 75
Leaving a profit of..........................	$ 7 25
And taking 300 days per annum.................	$2,175 00

Or equal, say, to..........10¾ per cent. per annum.

If 60 lights are used, at 40 cents................	$24 00
Cost same as 50 lights..............................	12 75
Leaving a profit of..............	$11 25
Or taking 300 days per annum..................	$3,375 00

Or equal, say, to..........16¾ per cent. per annum.

Overhead line of same character $700, as against $4,000.

MR. R. W. POPE: I have no reliable information as to the working of these different systems, as my investigations were conducted in such a way as to preclude the possibility of acquiring it. To determine as to the general character of the work, it occurred to me that there may be gentlemen present in this Convention who are familiar with some of the systems and some of the troubles connected therewith; therefore, I have not gone into that question. I simply state the facts as I found them. The drawing which I referred to accompanies this paper, and is open for inspection.

THE CHAIRMAN: Any member of the Convention can examine the drawings. Would Mr. Callender like to say a few words on this question?

MR. CALLENDER: I would like to speak later on, Mr. President, after some of the other gentlemen have spoken.

DR. MOSES: I listened to the paper of Mr. Pope with much surprise, because the Convention cannot begin to conceive the labor he took in gathering the facts upon which he based his generalizations. I happen to be in a position myself to know of his assiduity in following up this question; and when he says there are 100 different plans, that means that he has investigated 100 different plans—very different, indeed, from reading

the statement. It required his attention for many days, under great inconvenience occasionally, in order to gather that knowledge which he has epitomized. The subject is one that is new; and, of course, every one that had anything to say on it presented plans before the Underground Commission in New York, that being the point most prominent for the inventor. The Underground Commission examined all these things, and it is really surprising what ingenuity has been expended. Looking upon it philosophically, before the actual demand for underground systems arises, we find on hand pretty much all that is necessary. There are some companies, however, who have had the courage to put this thing into actual practice. Notably, the Philadelphia Company, of which he spoke, and the one in Chicago—the Dorsett Company, I believe. It may be interesting to the Convention to know that the problem is a very difficult one. There is steam-heating to be overcome. There are gas-pipes that thread their ways most tortuously under every street. Subterranean New York is getting to be something like subterranean Rome. There are layers of gas-pipes; those that have been cut off and neglected, and those that have been twisted away by other companies. Altogether, there is a perfect net-work, combined with the sewer system, water system and others, that makes it a very difficult problem in New York to handle. Any system, however, that is to be adopted there, must be one of a combined character, though not necessarily a system that can be carried out in its entirety in every street. However, there are some systems that can be very largely introduced. Then, again, in other places, it would be necessary to combine. The problem, if solved in New York, and they promise to do it very soon, will, I think, very much facilitate those who wish to put down an underground system elsewhere, because this combination system, if it is introduced, will give all the necessary information; and I think that members of the Convention who have that at heart can possess their souls in patience, in the meantime leaving very well alone.

The Chairman: The Convention would like to hear from Mr. De Camp on this question.

Mr. De Camp: We have made many experiments, but have not met with great success. We put three in operation since the middle of November. One of them came to the inevitable about two weeks ago. The other two held out, and were in operation when I left. One of them, however, had been running about three weeks when it was taken out, corrected, and put down again, since which time it has been running, apparently, all right. I have just received a dispatch from our superintendent, which says: "The two cables have both given out."

A Member: What kind of wires are they?

Mr. De Camp: I suppose they are the regular line wires.

Mr. King: Not laid in a conduit?

Mr. De Camp: No. We have not been at all encouraged with any experiments that we have made. One of these—I will not mention the name, because I do not think it is proper to do so, and we may yet make a success of it, for aught I know—we scarcely expected to succeed. It was one of those things that did not commend itself to us from the start, and the person who had the idea acknowledged that he did not know anything at all about it. He had been told that certain material was a good insulator. We gave him permission to try it, and it turned out to be a failure. The other was presented by a man, as I understand, of considerable knowledge in that direction, for which reason we had a right to expect success.

Mr. King: I would like to ask Mr. De Camp what he knows of the running of lights on wires through a conduit.

Mr. De Camp: I do not see that the conduit will make any difference. We must get a wire to go through, properly insulated, irrespective of the conduit, impervious to all the influences to which it may be subjected underground. When we have found that, we must adopt a conduit or some method convenient for putting those wires underground. There is another

thing: We run down a line of street sixty feet wide; and when I say sixty feet I mean a Philadelphia street, which is sixty feet from kerb to kerb, and twelve feet on each side. Suppose you put the conduit in the centre, then you have forty-two feet from your conduit to the house. We cannot afford to build miniature conduits from the conduit proper to the house. If we do, the mileage of our miniature conduits, as I call them, would exceed that of our main conduits by a great deal. Now, the method generally used in Philadelphia is to put an ordinary gas-pipe around the wire. Now, if the gas-pipe has anything to do with it, why not dispense with the expensive iron conduit. I think that settles the question that there is no particular merit in the conduit, so far as helping the insulation of the wires is concerned. In many cases they simply take a wire, insulated by being covered with a lead casting. I do not see why this would not answer just the same purpose as a pipe. But I cannot see anything in the conduit. When you discover something as an insulator that is absolutely reliable, you may be required to adopt some entirely different form of conduit from what has ever been devised.

In Philadelphia, I think, the top of the conduit is probably at an average of about 15 to 18 inches below the surface of the ground. Our Board of Supervisors has passed a resolution that no conduit shall be laid less than two feet below the surface. In Chestnut street, for about two-thirds of the way below Broad, there is no room, if I am properly informed by the Survey Department, to lay a six-inch pipe. There are two lines of water-pipe, two lines of gas-pipe, a sewer, and the present conduits. There may be something else. That is the case in a great many streets. In a street like Park, which is very broad, there may be room. We have a peculiar city government. It is the only one the *Lord* ever made. There is a peculiar way of taxing the people. The gas company furnish the city with light for nothing, but the city owns the gas works. And it is clear that the private consumer is taxed, through his gas bills, to pay for lighting the

city. There have been passed, I suppose, six or eight ordinances on the question of underground wires. When the ordinance fixing the time for putting the wires underground was passed there was an amendment adopted that city wires should not be included. Some one asked, "Why so?" "Why, the city hasn't money enough," was the reply. So far, at least, as the main lines are concerned, there is no reason why they should not be buried. The city has always been exempt by the different ordinances on the subject.

Mr. Hotchkiss: I do not think there is a doubt in the minds of the gentlemen present but that wires can be placed underground and made to work successfully, provided a proper quantity and quality of material is used. Whether the investment will be remunerative cannot be determined by some town in the State of Wisconsin in comparison with the city of New York or the city of Baltimore.

Mr. King: In our locality there are various objections to a conduit system of any kind. It seems to me that a conduit must, of course, be rigid, and any disturbance of the soil, either by force or by the breakage of water-pipes, would endanger it. In our climate, especially, where the frost during the winter prevails down toward that point in which the Universalists do not believe, it would be a very expensive thing to lay a conduit. Our frost sometimes gets down eight or nine feet, and I agree with Mr. De Camp that, if we go underground at all, the conduit seems to be a useless thing. I think we ought to stay on top of the earth for a while longer.

Mr. Callender: I begin to think that Mr. De Camp is somewhat in a position as the evil spirit of underground wires. In every experiment that has been undertaken in Philadelphia, the result, as he informs us, was a lamentable failure. I do not think it is quite creditable to engineers, electric light people, and those interested in the subject, that the statement go forth from this Association that gentlemen here have experimented with underground wires, and find it quite impossible to run their arc currents underground.

These are the facts that a man would gather from listening to Mr. De Camp to-day and at our last meeting in New York. I think any of you who have given any careful consideration to the question of what is necessary for underground wires, as Mr. Pope evidently has done, from the very careful paper he read to-day, must come to the conclusion that two things are necessary before you can get an underground circuit to work satisfactorily. It is not sufficient to get an insulated wire and bury it in the earth. An insulated wire will not turn a pick or other instrument with which it may be struck; nor can it, by any possibility, resist the action of stones or sand, or any similar material that will be found in the earth. You must provide yourself with a conduit and with an insulated wire. An individual piece of underground work must be looked upon as a special piece of engineering, and difficulties occur in this special piece of work that have to be specially overcome. It is no use for any man to come to you and say this is the only way to put wires underground. This is absurd. Take a territory in which wires have been put underground. In the putting of those wires certain principles have been evolved. You must adapt these principles to the work which you have to do. Mr. De Camp desires to put his wires underground. There is no difficulty at all in his doing so. There are several reputable manufacturing concerns that stand ready to make their word good to do underground electric lighting satisfactorily. We completed a plant in Washington in November for arc lighting. It was for the United States Company for their new station near the Capitol. All the wires from the station go from one spot overhead to a pole, and thence they go underground. Most of them go two-thirds of the way up Pennsylvania avenue, and some through the Capitol grounds to the Capitol. There are in the neighborhood of twenty miles of arc wire that have been working underground, both in the United States and the Thompson-Houston systems. Tests have been taken of those cables recently, and they are perfectly satisfactory. There can be no deteriora-

tion in a system that is thoroughly well worked out and thoroughly well laid. I do not wish to say anything further. I do not wish it to go from the Association that the underground wire question is one of which you cannot see any successful ending, and of which you are afraid financially. The calculations, gone into by these companies that have gone underground, show that it is economy to do so. I refer you to an article that appeared last week in the *Electrical Review*, describing Mr. Hapgood's experience in Detroit. There he finds it is economy to use his wires underground in the Dorsett conduit.

MR. DE CAMP: I do not wish to be personal, but the circumstances are such that probably it may be so considered. When Mr. Callender referred to this matter I think I understood what he meant, viz.: That the cable he put down for the Brush Electric Light Company was injured through neglect on our part, or some misjudgment in laying the cable. I brand that as false. And when he comes to me and shows me a place as big as a knife-edge, and says that is the fault of the mechanic, I say his judgment is not worth anything. The very fact of the cable breaking, or a leak, has destroyed any possible evidence of the cause of it. Any man who has ever connected light wires knows what that is. Every one who has come there to make experiments has had proper attention paid to him. Every facility has been offered to him honestly and in good faith. Save one exception—omitting these two which I have not heard from—in every instance our co-operation has been abused in one way or another; and I consider the remarks of Mr. Callender as abuse. The exception was a man who, when he failed, acknowledged his failure, and closed his mouth. Now, we have made experiments for, I suppose, fifteen people. We do not decline to do it yet; but we have not met with the same courtesy that we have extended to them.

MR. MORRISON: It would be a pity to let these questions pass without saying something further. No electrical engineer would dare to stand on this floor and say that it is an impossible thing to place the electric

lighting wires underground, and have them successfully operated. It is possible, and it is feasible. The enormous cost of such an operation, however, stands as a bar to the work, while the capitalist would be called upon to invest his money and look upon it as an operation, experimental in this country to a certain extent. The fact that wires are being successfully operated underground settles that question. In the city of Washington, where they will not permit the putting up of any new lines overhead, they are operated with success. In Europe most of the wires of the large cities, in one shape or another, are operated in conduits that are provided for wires, and for other purposes, at the same time. The history of these underground matters on the other side of the water is the history of the telegraph and of electric matters generally. It is not worth my while to go into it. It has been all talked over, so that the question has about settled itself. Our case—I now speak from the electric lighting standpoint—is about this: In the city of New York the most searching investigation is being made in this direction, not for the purpose of settling the question as to the possibility of placing wires underground, but as to adopting the best method already provided for that purpose. We take it that it would be unfair to the men who have put their money into this business, and who have plants of overhead wires, to compel them to adopt any system until this question has been, to some extent, settled, not only by providing the means of placing the wires underground, but by giving us the right to wait a reasonable time after such system has been adopted by the New York Sub-Ways Commission to allow us to see whether it is a success or not. I would like to treat every system fairly. I have tested, under my own hand, two plans for underground wires; one a system of placing a bare wire in a bed of bitumen—Rittenhouse's plan it was called. He had a lot of buttons strung on a wire, which he put in asphalt. I told him the buttons were of no account, and he put cubes of terra cotta on the wire, and buried it in the bitumen. Now, that plan did not receive exactly fair

play. As I passed through the prison-yard, where the experiments were being made, and out again on Van Buren street—a distance of about three-quarters of a mile—I saw that the workmen were dropping the sand in with the bitumen. The line operated for about two or three months, when it began to show faults, and grew worse and worse until we had to abandon it. The other experiment was made in the same neighborhood by me with a cable covered with kerite. The wire was buried underground, and carefully watched day by day by myself and Mr. Orford. It showed little or no signs of deterioration. We kept it underground, in actual service, working in a circuit along with about forty or fifty miles of No. 4 overhead wires.

This was a stranded cable with about $\frac{3}{32}$ of kerite insulation on it. We worked through this cable and through the varying distances of wire, coupled up in these circuits, and operated from 20 to 60 lights over 50 or 60 miles of circuit, including this cable. We had no difficulty from the cable, and only removed it when we had to use the locality for some other purpose. It was in service for about eight or ten months without showing any signs of deterioration. These are the only two experiments that I have seen made. In the first place, we do not want to place our wires underground. In the second place, we insist on fair play on the part of legislators; that they will keep their hands off until something has been reached by the Sub-Ways Commission engaged in solving this problem—at least until they have gone before the world with some settlement of this difficulty from their standpoint. After they have done this, and the plan is adopted, then give us a reasonable time to see whether that plan is a proper one. After that it is perfectly proper for the authorities to come along and say: There is a plan, use it. When the time comes I do not think you will find any difficulty from any electric lighting man on that scale. There is less difficulty from our side of the house than from the telegraph people, because the placing of an electric lighting wire under ground is very little more expensive than building it

overhead. We do not want to avoid the underground business particularly; all we want is, for them to say to us: Here is a system properly devised and tested, and here are the results.

Now, the Callender Insulating Company have placed wires underground in conduits in Washington; and up to the present time—I have it by authority from Mr. McAleese, the Superintendent of the Police and Fire-Alarm Telegraph of Baltimore, that it is giving good satisfaction. In Baltimore the Mayor of the city takes strong ground in favor of abolishing overhead wires. You cannot make a telegraph or an electric light pole an ornament; it is more or less a nuisance on the streets; and so those interested in the appearance of the city would like to get rid of these wires. The Mayor has used pretty strong language in the matter of underground wires. He says: "There are no two opinions in this community concerning the necessity and expediency of an early abolishment of the overhead city wires now in use, the expansion of which has become so great as to be justly and generally regarded as an intolerable nuisance, while the wires themselves are terrible to the imagination as suggesting an increased loss of property and life in case of fire. The poles are an encumbrance to the sidewalk. They form a mass of unsightliness," etc. He expresses in this about the sentiment of it. You have statements from Mr. McAleese, giving the result of his observations in the different cities where the underground system is used. Legislation will probably be asked in this city looking to experimental work, so that in the coming year you will doubtless have before this Association the result of many practical experiments. Sometimes you find the Chief Engineer of the Fire Department making a report about the danger to the men from the electric lighting wires, but none of these are true. I never knew a fireman to be killed or injured by a shock from an electric light wire. You see extraordinary stories printed in the newspapers once in a while about this question. The Chief Engineer of the Baltimore Fire Department puts himself on record in a

report (which will be preserved in the archives of the city) as saying that numbers of lives have been lost through the fire-alarm telegraph. For those of you who have not the honor of an acquaintance with this gentleman, I beg to say that that is about on a line with the general statements he makes with regard to every matter, public and private. I do not know whether he would have sense enough to tell the truth if he knew how. But when you take a city official in such a high position and permit him to display such malicious ignorance as he has displayed in the report above-mentioned, it is time to infuse a little more brains and less muscle into the government of the Fire Department. I must leave this underground question with these few remarks. I think fair play would indicate a waiting policy on the part of the State and municipal governments, until the time has arrived when some solution of this question has been made by those engaged in endeavoring to solve it. I think that we should treat the case with grave consideration, and endeavor to treat every man who is engaged in this line of business with absolute fairness, because the man who really solves this problem, Mr. President, the man who brings before the public a real solution of this question, will be to my mind a public benefactor; and when that time comes, and the successful system is laid before you, and you can put your wires underground at a reasonable expense for plant and maintenance, there is not a man engaged in this line of business that will not hail it with as much joy as will those whose æsthetic tastes are shocked by the telegraph wires and posts in the streets of the city. [Applause.]

Mr. Weeks: In relation to what has been said, I would like to add a word, and it is this, that the attitude of the people toward overhead wires reminds me of the familiar quotation, "Whether 'tis better to bear those ills we have than fly to others that we know not of." It seems to me they do not stop to think of the consequences of placing electrical wires underground. Take our own city, for instance, where we now have a

gas company and a water company with the right to tear up the pavements of the streets and lay down their mains, in addition to a very extensive sewer system. Now, to compel three telegraph companies, two district companies, an electric light company, and a telephone company, all to place their wires underground, giving them the right to tear up the streets, alleys and avenues of the city, it seems to me that if the people sanction this they do not think of the consequences of such action. The sanitary view of the matter is a very important one. We would have all sorts of fevers and malaria, and with our narrow streets and rapidly increasing business, our thoroughfares would become impassable; and with electric companies the placing of the wires underground would be but the beginning of the nuisance, because whenever there is trouble there would be the necessity for extensive excavation. I endorse all that our President has said in regard to waiting. I think that is our true position. We should wait until there has been a suitable system found, and it has been demonstrated to be such. Then, when that time comes, I will favor an underground system, provided the people, after an intelligent review of the objections to it, conclude that the objections to the ærial system are sufficient to warrant them in putting up with the others.

MR. RALPH W. POPE: I would like to say one word touching this question about the pride of the people. I think that has been misunderstood. The way I have looked at it all the time is that the press, under some mysterious influence—we may not know exactly what it is, but we know it is there—has been very industriously manufacturing this public opinion and advertising it; and, as an example of that, just before leaving New York on a tour of inspection in connection with this business, I saw in the *Times*, of that city, a statement to the effect that while the commissioners of New York were wrestling with this problem, Washington and Philadelphia had already placed their wires underground, and, on examining those localities, we found fully as many wires overhead in proportion to

the size of those cities as there are in New York. A similar state of affairs existed in Chicago—although I believe some of the wires are to be taken down. Instead of Washington and Philadelphia having buried all their wires, it is a pretty well understood fact that there are actually more miles of wire underground in New York city than there are in either of the cities we visited. There has been underground work undertaken by the telephone and the Western Union Company; and although none has been done by the Arc Lighting Company, there is an extensive system of incandescent lighting wires there, so that instead of being behind, New York is actually ahead. Of course, citizens familiar with the streets of New York know that a great many wires are overhead yet. Another thing that is not generally understood by the casual promenader of the city is, that although the surface of the street may give you the impression that there is plenty of room below, when you see an excavation made, and discover the net-work of pipes crossing and re-crossing, mains, branches and sewers, it is quite a difficult problem to find plenty of room, especially in the down-town streets, where the problem of burying the wire is, of course, more perplexing than it is up-town. But up-town it is a financial question. There are not enough wires there to make it worth while to put them underground. The new manager of the telephone company finds that there are practically no telephones above Thirty-fourth street. I was talking with him the other day about putting his wires underground. I called his attention to the fact that the telephone service did not demand and could not pay for any system of that kind in that part of the city.

Mr. Henry W. Pope: I had the pleasure of serving on this New York underground committee some time ago. At the corner of Broadway and Wall street there are forty-five different underground structures. Now, this committee went pretty thoroughly into the subject, and came to the conclusion that about the only thing that can be used in the city of New York is a tunnel; and, I believe, because they made such a

recommendation as that, it was given out in the papers that they had been influenced in one way or another to make such a report. Nevertheless, I think that anybody who has looked into the subject comes to the same conclusion.

Mr. Cooper: As I understand it, there is not at the present time any question before the Convention, for the reason that all papers similar to Mr. Pope's, and his among them, are accepted and placed on file by the Association. I would, therefore, offer the following resolution:

"*Resolved*, That it be adopted as the sense of the National Electric Light Association that up to the present time there has been no system of underground wires that recommends itself to the electric light companies of America; and that unless something more feasible is presented, we earnestly protest against any enforcement of an underground system until it is proved beyond a doubt that by such adoption the usefulness or life of the electric companies is not jeopardized; and that we believe that up to the present time all the underground systems are more or less experimental; and that it is an injustice to expect the electric light companies to adopt any system that has not proved itself practicable."

The motion was seconded.

The President here took the chair.

Mr. Hotchkiss: The resolution as presented by Mr. Cooper should be placed upon record. The question is not one of means, ways or ability. It is a question of cost. It will pay some men in certain localities to put up a fourteen-story building, and in others to build a one-story wooden shed. Some men dig a cellar four stories under the sidewalk. Others have none. If we can receive an adequate return for the service that we give to the public, or to our customers, we are warranted in putting our wires underground. If we cannot get such a return, and our income will not permit us to make the expenditure, that is the only question we have to decide. Science and ability will give us the means of quickly satisfying our necessities.

Mr. Cooper: That is just the point that is meant to be covered by my resolution. As I understand this

underground question, it is an enforcement of the fourteen-story building that Mr. Hotchkiss speaks of, with four stories underground where one story would do. We do not want to be forced to build such a building unless it is absolutely necessary.

MR. KING: Can Mr. Pope tell us to what extent electric light wires are run through tunnels in Chicago?

MR. RALPH W. POPE: Two gentlemen from Chicago were associated with me on the work of this committee, and I relied upon them to give some further information to the Convention in regard to the question upon which Mr. King desires information. These gentlemen are not present, and I can only speak from recollection without having thoroughly gone into it. As we stood at one of the street corners in Chicago, I was told that there are eight different arc light systems that can be seen in operation from that point. Whether that is so or not I cannot say, not being familiar with them. There are certainly several large systems in operation there, but they are not carried out to the same extent that they are in other cities of the same size. They are more local in their character—isolated plants. I presume that some of the gentlemen present, (Mr. Hotchkiss and Mr. Callender), who have done some underground work there, can give the information you desire.

MR. KING: As a rule, Western men tell the truth; but occasionally you come across one who does not. Now, when I am at home, I learn that in the East the wires *are* buried. When I am in the East I learn that when I go back the wires *will be* buried. I came through Chicago the other day, and while there I met a gentleman who is in the electric light business. He told me, as a matter of fact—I presume the members of the Convention know it—that there is no public lighting done in Chicago, no central system of lighting, and that lighting there is done by isolated plants. He told me that there is only one electric light company which has any wires in the conduit about which we hear so much, and that company, I understood when I came through Chicago, was in the hands of the

sheriff. In crossing a street the wires must be run through a conduit of some kind; and as near as I can ascertain, that is all the underground business there is in Chicago.

THE PRESIDENT: The question is on the adoption of the resolution.

MR. WEEKS: I move that the resolution be referred to a committee of three, to report at our next session.

The motion was carried.

THE PRESIDENT: I will appoint on that committee Mr. Weeks, Mr. Cooper and Mr. Hotchkiss.

THE PRESIDENT: Here is a paper, which has reached me through the mail from Chicago, or some other place. It is an important paper on the electric motor, by Mr. Van Depoele; and, although that matter has been closed, I think it will be better to have this paper read. I think Mr. Van Depoele has gone a long way towards solving the question of electric motors. He has done more than any other man in the country in that direction. I do not except Mr. Spang.

MR. HOTCHKISS: Thanking you for your courtesy in appointing me as a member of that committee, I do not think it is consistent, considering the character of the business that I am in, that I should act as one of such a committee in this Convention. My opinions certainly would be biased.

THE PRESIDENT: The gentleman's modesty is only exceeded by his courteous demeanor. I appoint Mr. Ridlon in place of Mr. Hotchkiss.

Mr. Van Depoele's paper was read by the Secretary.

MINNEAPOLIS, February 7, 1886.

To the National Electric Light Association, Baltimore, Md.:

GENTLEMEN: I appreciate highly the honor you conferred upon me at the last meeting, held in New York, in appointing me to make a report with regard to the progress made in the electrical transmission of power, and I only regret not to be able at present to give a more detailed account of what has been done. However, I shall endeavor to show that electrical transmission can be used with economy on ordinary street railways, doing away with horses or with running steam engines; and in the absence of other data at command, I will take the liberty to

give you my own experience of the past few months, if this be acceptable to your honorable body.

During the summer months of 1885 I entered into a contract with the directors of the Toronto, Ontario, annual exhibition to run a train of three cars and a motor car from the street railway terminus to the upper grounds of the exposition, a distance of a mile. Having only a single track, I had to prepare here for a light train and good speed. The plant consisted of the following: One steam engine, 10x16, running 125 revolutions per minute, driving an ordinary 40 light (arc) machine, having an electro-motive force of about 1,400 volts, and an intensity of current of about 18 amperes. The engine and dynamo were placed in machinery hall, close to the boiler-room. The dynamo was connected, one pole with the rails, which were fastened together by means of fish-plates, and the other pole to an overhead wire, hanging over the centre of the track, by means of arms extending from poles placed along the length of the track. On top of the car, on which the motor was placed, was a contact-wheel carried by a pivoted beam, the latter being provided with a spring on one end pressing the wheel at the other end up against the underside of the overhead wire. This contact-wheel was in communication by means of a flexible cable with the switches, rheostat and motor. From the motor the current was carried to the axles of the wheels, the wheels to the track, thus closing the circuit upon the generator.

We began placing poles, etc., on the 1st of September, and made our first trip on the 5th. From the beginning till the end not the slightest hitch occurred, running regularly from 8 A.M. till 10.30 P.M., without stopping a minute. On many occasions we carried from 225 to 250 passengers. On one end of the track we had a 200-foot curve, then a level of some 2,000 feet with two curves of about 1,000 feet radius, then a grade of some 1,500 feet, gaining gradually to about 6 per cent. The rest of the road had a downward grade to the terminus, which made it a disadvantage in starting. As above said, the distance was a mile, and the round trip never exceeded 8 minutes; not including starting and stopping, we made for part of the way at least 30 miles per hour. During the last five days of the fair we carried 50,000 passengers. The consumption of coal, as given by Doty & Sons, who ran the engine, was on an average of 1,000 pounds in 10 hours.

The next step was to South Bend, Ind., where we equipped four ordinary street cars. One large open car, with a 10 horse-power motor, and the other three closed cars, each with a 5 horse-power motor. The large car was run for the first time on November 14, 1885, and was packed with humanity to its utmost capacity, everything working like a charm. The plant consists at present of the following: A 50 horse-power water-wheel, and

two 20 horse-power generators, and, as above stated, one 10 and three 5 horse-power motors. The track is laid with the ordinary flat rail, and in order to connect the rails together we placed copper plates 3″x12″ under the joints, and spiked the rails down upon the copper plates; this was done on both sides of the track, so that there is no chance of breaking circuit. As will be understood, the rails in the present case form again one part of the circuit; the other part consists of a copper wire ¼ inch in diameter, suspended above the track from cross wires fastened to poles placed near the curbstone, and at a distance of about 100 feet apart. From the under side of this copper wire or conductor hangs a carriage, fastened to a flexible cable, passing to the inside of the car, where it is in connection with the switches, the motor, etc. This carriage travels along with the car, and makes a perfect contact. After the first trial of November 14 the 5 horse-power motors were soon in place, and have worked admirably well. The tracks are never perfectly clean, on account of constant traffic over the road, but since both rails are connected, and also all four of the wheels, it is almost impossible to break circuit between the motor and the rails. The cars have run right along, through mud and snow, and no trouble has been experienced with the circuit.

On running the four cars at once the generators work perfectly, from 6 at morning till 11 at night, requiring not the slightest attention. The brushes are set in the morning, and are not touched afterward. Every car works independently, back or forward, without interfering with the others, and the division of the current leaves nothing to be desired. The only trouble we have encountered with the plant has been with some small mechanical details, such as link-belts breaking, etc. These, of course, being small matters, are easily perfected. The main point here was the electrical part, and this has proved to be an unqualified success. There is no wear to speak of on the generators, and the same can be said of the motors. The motors are placed under the cars, between the wheels, and connected to the axles by means of link-belting. At either end of the car is placed a dial plate fastened to the dash-board. Over one-half of this plate moves a handle directing the motion of the car either forward or backward. Over the other half is another handle, by which the speed is regulated. When full current is turned on the maximum speed of 8 miles per hour is attained, and this speed cannot be surpassed; six to eight miles per hour being the maximum speed allowed within the city limits on any ordinary tramway.

The length of the present road is about 2½ miles. The other roads will be equipped as soon as the weather permits the placing of the poles for the cross wires.

On the 6th day of October, 1885, we entered into a contract with Mr. McConnico, president of the New Orleans Exposition, to run a train of cars in the grounds with a carrying capacity of from 180 to 200 people. This road is similar to the one in Toronto, nearly a mile long, running from St. Charles street (main entrance) along the Government buildings, through the grounds, to the main building and art hall.

All was ready for operation for the opening day, but on account of delay in obtaining steam power we only began running regularly on the 14th of December.

The generator is run by an engine, 12x18, running 100 revolutions per minute. The generator is of 35 horse-power capacity. The motor is placed in the centre of an open car, only taking away the two middle seats, thus leaving the other seats for the public. Besides this, there are two more large open cars. The car containing the motor is provided with a contact-wheel pressing up against the under side of the overhead wire, as in the Toronto road. This train runs regularly from 8 A.M. to 7 P.M., and has up to date proved a perfect success. The maximum speed is 15 miles per hour.

The heaviest work we have done so far is in Minneapolis, Minn., and that during the winter months, when snow and ice are faithful companions on the track; whether invited or not, they are there, never fail.

Before undertaking the job, I was very much afraid that electricity would not be practical in a climate where the thermometer rises seldom above the freezing point for at least three months of the year. All my fears, however, have been removed in the past six weeks. We have ascended the grades and turned the curves with at least as much facility as the steam dummies. On one occasion the steam dummy brought us down to the road where we had our electrical connections. The steam dummy got stuck with our motor car and a large open car, the latter about 50 feet long. We dismissed the dummy, and as soon as we had current on we furrowed our way through the snow and had the track clear in a short time. This proved that we could do at least as much as the dummy.

A brief description of the track will give an idea of the work done by the motor. Starting from Bridge Square is a curve sixty feet radius. The road is then straight for about a mile, but rises and falls continually until Thirteenth street is reached. Here is another curve of 50 feet radius, to the right. One block further is a similar curve, to the left, the rest of the road being straight, but continually rising up to Twenty-fourth street, the top of the hill. The steepest grade is about 1,500 feet long, and 6 per cent. beyond this is a switch and the termini of our present electrical equipment.

The electrical plant consists at present of one 60 horse-power generator and a 50 horse-power motor. Our circuit consists of the rails for one side, and an overhead wire, $\frac{3}{16}$-inch copper for the other side.

Whereas, in South Bend we have water-power as the prime motor. We ran for the first time on New Year's Eve, 1885, and continued on New Year's Day. The water-wheel had no governor, and we found it rather dangerous for the generator; as the water-wheel had to be governed by hand, it was impossible to keep the speed anywhere near constant. It was decided to put a governor on before running regularly. Several trips, however, were made over the entire length of the road, giving entire satisfaction. The weight of motor is 3,500 pounds, and the total weight of motor car or electric locomotive is 8 tons. The passenger cars in use here are similar to those on the New York Elevated. While the water-governor was being made, a steam engine, with a 12x18 cylinder, 125 revolutions per minute, was used, and, although too small for the purpose, very satisfactory work has been done. In some instances we had three or four inches of solid ice on the track, and broke our way through it without the least trouble. In a few days the water-power will be in shape to run regularly, when we will run on schedule time.

Thus far we have demonstrated that electric railroads can be operated anywhere where the steam motor can go; and that there is much in favor of electric-motors in cold countries, is very evident. There is no danger of pumps freezing up, nor of brakes becoming inoperative; no water tanks are needed along the road, nor is there any coal to be taken; in fact, there are thousands of advantages in the application of the electric locomotive on street and other railroads. Whenever water-power is obtainable the economy need not be disputed; and even in the case where steam is to be used as a prime motor there will be considerable economy.

No cheaper nor better plant can be expected to run light trains on suburban roads than the electric-motor; as, for instance, in the Detroit road now in progress, connecting the latter city with Dearborn, a single train will be run with six large-sized street cars; the speed will be from 15 to 20 miles per hour. The length of this road is nearly three miles, and will be in operation in a few weeks.

A similar road will be in operation early in the spring in Appleton, Wisconsin. In this case, however, six cars will be equipped with 10 horse-power motors, and run independently. The length of road is about 8 miles; the speed about 10 miles per hour. Water-power will be used to run the generators.

The street railway in Montgomery, Ala., is now being equipped with our motors, 12 cars in all, and will be running within 30 days.

In all the above places we are using overhead conductors, which are no more of an obstruction than the ordinary telegraph and electric light wires; in fact, much less, since the conductors are over the centre of the roads; so, wherever wires are allowed for other purposes, they cannot be refused for the present purposes. I do not believe, however, that overhead wires would be practical in large cities where other wires have to be buried; but in this case the electric conductors can be placed underground in conduits similar to those used for cable cars. This will be much more expensive than the overhead conductors, but it will be a permanent and practical fixture.

I feel sorry that I have not found more time to prepare some figures with regard to tests of motors and general transmission; but the above is a *resume* from practical experience and facts on the track, instead of on paper. I am a solid believer in the saying that experience is the best teacher; and to all the above I have attended personally from beginning to end, and am more than ever convinced that the electrical transmission of power has ceased to be ephemeral, but has become a real fact and a blessing to the world. All is ready; it has only to be applied judiciously, and success is imminent. Thousands of horse-power are now running waste in our water-falls which can all be utilized to advantage, in some cases running our tramways, in others our factories, etc., giving at the same time light and cheer during the absence of Old Sol.

With regard to the measuring of currents of high-tension, I am unable to get anything ready, for the present, worth while, and I hope that this want will be filled by some of our worthy confréres. I may say here, however, that for the every-day practician all there is needed is a good ampère and volt meter, direct reading. These instruments of different capacities can now be bought at reasonable prices. Duprez & Carpentier, of Paris, France, furnish a good instrument; and also Ayrton & Perry, of London, England, and many others. No company furnishing electric lights should be without a set of these instruments; they will be found most useful in many cases.

Respectfully,

[Applause]. CHARLES J. VAN DEPOELE.

THE PRESIDENT: There is a gentleman present who represents the Chemical Electric Light and Power Company of Boston. His system is one by which small plants of incandescent lamps can be run at moderate cost. I will ask Mr. Allan V. Garratt to address the Convention on this subject.

MR. ALLAN V. GARRATT: *Mr. President and Members of the National Electric Light Association*—When he stood up to advance those principles of astronomical science which have since given his name a world-wide reputation, Sir John Herschel prefaced his remarks by saying that "Every student who enters upon a scientific pursuit, especially if at a somewhat advanced period of life, will find not only that he has much to learn, but also much to unlearn, and, as a first preparation, therefore, for the course he is about to commence, he must loosen his hold on all crude and hastily adopted notions, and strengthen himself by something of an effort and a resolve for the unprejudiced admission of any conclusion which shall appear to be supported by careful observation and logical argument, even should it prove to be of a nature adverse to notions he may have previously formed for himself or taken up without examination on the credit of others. Such an effort is, in fact, a commencement of that intellectual discipline which forms one of the most important ends of all science."

I need not tell you, gentlemen, that I have not come here to warn you against forming crude and hastily adopted notions in regard to the electrical system which I represent, for I believe that the electric light companies of this country are represented by men who do not jump hastily at conclusions, and who are not in the habit of taking things for granted; but I ask you, in all fairness, not to class unthinkingly one system of lighting with those inventions which periodically appear before the public with meteor-like brilliancy, claiming to do that which every scientist knows to be impossible with the materials at their disposal; companies whose exodus from the business arena is as sudden and—to the uninitiated—as unexpected as their advent, and in regard to whose end we must remain silent if we wish to be charitable.

Had it not been for the scholarly paper (by Dr. Moses) to which we had the pleasure of listening yesterday morning, I had intended to speak in detail of those early experiments with the Voltaic current—experiments beginning with Professor Volta, of Pavia, in the year 1800, when he constructed his electric pile, followed by his *couronne de tasses*, or crown of cups, which suggested to Sir Humprey Davy his brilliant experiment of the same year, when he dazzled the whole world by producing for the first time the electric arc. These experiments were followed by others so numerous that, were I even to enumerate them, I am sure I should be imposing upon your patience. It is sufficient to say, that in the years which followed, a few scientists, conspicuous among whom were Daniel, Grove, Snell, Bunsen and Poggendorf, won for themselves renown which is historic.

I need not remind you that there are especial points of activity and stagnation in the history of all science, and that at about

the middle of the present century electricians had well nigh abandoned the hope of producing powerful and continuous currents of electricity by primary batteries, when the attention of electrical investigators was turned more especially to the theory of electro-magnetic induction, as advanced by Faraday as early as 1831, after which followed many inventions, conspicuous among which were those of Pixii, Paccinotti, Siemens, Wheatstone and Gramme. In this way the whole question of producing powerful currents of electricity by purely chemical means fell into the background, and became looked upon as a thing of the past, and the problem of converting the heat which accompanies the rapid oxidation of fuel into motion, and from motion into electricity, became the absorbing question of the day.

The latter half of the present decade has, however, marked an epoch of remarkable activity and interest in the subject of producing powerful electric currents by primary batteries, and electricians are now working actively on this question.

In the present state of the art, it is not becoming in any man to stand upon the floor of this Convention and claim to do with a primary battery that which can be done with a good dynamo machine; but, as you know right well, the question is not always, How much electric light can you produce within economic figures? but you are oftentimes asked, How little light can you furnish from an isolated plant at a price which consumers will pay?

This is precisely the question which I am prepared to answer. A primary battery, capable of successfully lighting for a number of hundred hours a single incandescent lamp, or, if necessary, a score of them, is not an invention to be put aside as wholly insignificant.

I speak conservatively when I say that it makes not only possible, but feasible, the electric lighting of a single house, a yacht, a parlor or sleeping-car, or even a man's own private carriage. It also places at the disposal of every physician and surgeon a light always ready, and requiring but little care, with which he can explore the interior of the human body. I need not suggest other uses for such a light; they suggest themselves to every one. This is a field of electric lighting which is out of the reach of the dynamo machine.

The Chemical Electric Light and Power Company, of Boston, of which I am the representative, is to-day putting out plants for the purposes which I have enumerated. It controls by letters patent the use in a Voltaic battery of those chemicals which alone make possible practical results.

Heretofore, a battery which could maintain an electric light for twenty hours was looked upon as phenomenal. The Chemical Electric Light and Power Company has placed a plant in the

New York Mutual Life Insurance Building, of Boston, which gives the elevator car three hundred hours of good light with one charge of battery solution. We are furnishing light at prices which we find the consumers are willing to pay.

I have intentionally refrained from going into the details of construction of our battery or the composition of our solutions. I should not feel justified in occupying the floor of this Convention for any such purpose. I wish simply to say, that we have no secrets, and the structure of our battery and the chemicals which we use are at all times open to inspection. The time has gone by for any one to claim to produce electricity or electric light for the public in any way which does not appeal to the good judgment and common sense of practical men, who are skilled in this particular branch of applied science.

I will not longer take your time with this matter. In closing I wish to say, that it has been to me a pleasure to bring before the National Electric Light Association the first practical device for producing the electric light in commercial quantities and within economic figures by purely chemical means, without the intervention of any mechanical force whatever. [Applause].

Mr. Weeks: The legal phase of our business is something that has been overlooked so far; that is, the legal relations of electric light companies to the Patent Office and the communities in which they operate, etc. In order to bring that matter before the Association, and put it in proper shape, I offer this resolution:

Resolved, That a committee of three be appointed by the Chair —*of which I shall not be chairman*—to consider the legal relation of electric lighting to insurance; the legal relation of electric light companies to the public; the legal relation of electric light companies to telephone and telegraph companies; and the relation of electric light companies to the patent system.

The resolution was adopted.

The President: The Chair will appoint Arthur Stewart, of Baltimore; A. J. De Camp, of Philadelphia, and Ralph W. Pope, of New York, as that committee.

The Convention then adjourned until ten o'clock on the following day.

THIRD DAY'S PROCEEDINGS.

February 12, 1886.

The Convention was called to order at 10.15 A.M. by the President.

MR. DE CAMP: I want to offer an amendment to the Constitution:

The Secretary read the following proposed amendment to the Constitution, as a substitute for Article 4:

ARTICLE IV.

The officers of this Convention shall be a President, two Vice-Presidents, a Secretary and Treasurer, and six members as an Executive Committee, four of whom shall constitute a quorum. All officers shall be elected by ballot for one year, or until their successors be elected and qualify, except the Secretary, who shall be appointed by the President. All vacancies to be filled by the Executive Committee.

The amendment was adopted.

The Secretary read a letter from the Brazilian Minister to the United States, acknowledging an invitation to be present at the Convention, and expressing his regret at his inability to attend.

MR. WEEKS presented the following report on the resolution offered by Mr. Cooper:

Your committee make the following report:

Resolved, That it is the sense of this Association that no legislation looking to the placing of wires underground should be enforced until it has been proved beyond a doubt that by such an act the usefulness or life of the electric light companies is not jeopardized; and, further, that it is the sense of this Association that up to the present time no such underground system has been put in practical operation.

CHARLES COOPER,
FRANK RIDLON,
E. R. WEEKS,
Committee.

The resolution proposed by the committee was adopted.

THE PRESIDENT: The next thing in order is a paper on "Operating Expenses," by Mr. Weeks:

MR. WEEKS: Were it possible to make an estimate of operating expenses that would be an average for all parts of the country, and for various plants, the result would be of comparatively little value. Conditions are so different that exactly the same plant would require a much larger expenditure in one locality than in another. Water-power may be available in one city, and the operating expense of the power department be reduced to an inconsiderable amount. Again, proximity to fuel supplies will give this item a subordinate place. The wide differences in the size of plants do not make a corresponding difference in expenses. Even in a given plant an increase in the number of lamps does not equally affect the expense in all departments, nor is the change in operating expenses in direct ratio to the increase. A plant of incandescent lights does not give the same relative per cent. of expenditure for lamps and for power as obtains in an arc plant, the single item of attendance in the lamp department being much less for the former.

In making an estimate of operating expenses, therefore, it has been thought best to take as a basis an arc plant of 200 lamps, and leave as much margin as possible for the varying conditions which affect the cost of labor and supplies.

As water-power is available in few cases, it has not been considered, this report being based upon the supposition that most plants must be operated by steam, which necessitates large expenditures for machinery, fuel and attendance, and renders the question of economic measures highly important, both to the furnisher of light and its consumer.

In establishing a plant two items enter into the calculation of financial returns—the original cost of machinery and the expense of running it.

In no other business does so close a relation exist between the quality of machinery, the operating expenses, and the net gain. In other industries it pays to buy the best implements; in electric lighting anything else is a loss. Reliability is the first consideration. It is not necessary to say to a body of electric men that stoppage means rebate; rebate means loss, not only in immediate returns, but in confidence from customers, and, so, *greater* financial loss.

Every piece of machinery should be chosen, not with reference to its price, but to the dependence that can be placed upon its steady, efficient service. The best engine is not good enough. Many a lighting plant has failed because of a poor one. There

should be an automatic cut-off, and all bearings should be large and strong. The governor should be perfect, so that a change in load would not result in a change in speed, and a consequent variation in the lights. If given its maximum load, a large engine is much more economical than a number of small ones; but in case of stoppage the loss increases in proportion to the number of lights.

Economy requires a fair grade of oil freely used. Heated bearings result equally from the clogging of poor oil and the stinted use of a good one; and they necessitate stops, with a consequent loss of time and its aggravating train of results. The seeming waste from a free use of oil may be prevented by a system of drainage which will preserve the drip to be used over again, and finally to be sold.

Where the water is full of impurities *special* attention must be given to the construction of the boiler, which should be such as to allow a free circulation, and render all parts easy of access. The *best* boilers require frequent cleaning, with thorough inspection at least once every three months. Heaters should be of such design, grates of such pattern, and all steam apparatus so set up and adjusted as to allow the use of the lowest grades of fuel in the most economic way. Fuel being a heavy item of expense, an attentive fireman, capable of intelligent judgment as to the greatest amount of heat to be obtained from a given quantity of fuel, is a profitable investment; $2 per day is but value received for the services of such a man. In a 200 arc plant he can save more than his salary, and, in addition, can produce from a cheap grade of coal better results than can be gained by the ignorant use of the most costly fuel.

As was plainly shown at our last Convention, the cost of fuel is a widely varying item; one, indeed, upon which there seems to be no common agreement, except the desire to reduce it. According to the varying grades, different methods of handling, from 3 to 14 pounds of coal per lamp per hour are required, the price ranging from $3.50 to 50 cents per ton.

As the most efficient service demands the closest attention on the part of engineer and fireman, too long a watch should not be required.

Basing our calculations upon a good mixture of slack and nut coal for a 200 arc plant, at an average distance from the fuel supply, the cost of the power department should be not far from 32 per cent. of the whole operating expense.

Even with the most carefully constructed lines, having supports not over 100 feet apart, inspection of the whole circuit should be made every two or three days—especially in cities where there are narrow streets or a great number of wires. A good line foreman is worth from $15 to $20 per week, and he

should keep his department within 7 per cent. of the total operating expenses.

Economy requires an absolutely automatic regulation of the current; and the most satisfactory service will be secured when the tension is not too high. The object sought should be, not the greatest amount of light on a given circuit, but the greatest amount consistent with a reasonable degree of safety.

The experience of several years seems to have demonstrated that a light double-leather endless belt, without rivets, is best, giving the greatest security against stoppage and a steadier pull for the machine than any other kind of belting. In the care of dynamos, cleanliness cannot be too rigidly exacted. *Cleanliness* here is the watchword, not only of success, but of true economy. A neat, rapid and observant attendant is absolutely necessary, that trouble and expense may be avoided. To prevent costly delays, all bushings, insulations, etc., should be cleaned daily. Frequent inspection of their condition should be made, and they should be found in a state that would leave the white kids of a West Point inspector free from the slightest stain.

The cost of running the dynamo department should form about 14 per cent. of the whole operating expense.

Single lamps with larger carbons, even when they must be re-trimmed during service, are more economical than the duplex lamps. The globes used on the latter are more expensive, and are more frequently broken. The unequal expansion produced by heating the side adjacent to the arc, and the sudden change in temperature from the shifting of the arc to the other side, always lead to this result in double lamps. The loss on them in this direction alone would almost pay for the extra service of re-trimming single lamps. Moreover, owing to the crowded condition of the box of the duplex lamp, it is more apt to get out of order, and, for the same reason, is more difficult to readjust; and, as carbons are not uniform in their lasting qualities, the loss from burnt holders reaches its maximum where this lamp is used.

Outside lights give more reliable service when hung rigid, and the same is true for inside lamps, unless a device similar to that exhibited at Chicago by the Western Electric Company be used. Light hard-wood ladders and a good lamp-man will have a better effect upon operating expenses than the ordinary loose tackle for raising and lowering. The ladder is, of course, less convenient, but a lamp properly trimmed by means of it is in no danger from the frequent variable contacts caused by raising.

In the use of carbons, a certain amount of waste must always result; but this item can be considerably reduced by trimming short-time lamps with pieces. The carbon question properly belongs to another committee; but it may be said here that cheap grades are a constant source of annoyance and loss.

Globes are a vexatious part of the best lamps, and swell the item of breakage, despite the utmost care. In fact, there is no profit in them except for the manufacturer. Nine-tenths of this breakage is due to the unequal expansion resulting from overheating. The most feasible of the proposed preventive measures would be the use of a sheet of asbestos packing, which would insulate the globe from the undue heat at the lamp base.

Perfect trimming of lamps, as early as possible in the day, should be insisted upon. Switches, bases and all contacts must be well cleaned. Rods should be wiped before being pushed up; and in scouring them nothing but crocus cloth should be used. In exposed places they should also be provided with protectors. All screws and contacts must be kept tight. A careful lamp-man, without patrol duty, can trim 100 lamps per day; while for one who patrols his own circuit, from 25 to 50, according to distribution and service, is a reasonable number. Such men are worth at least $1.50 per day.

With reference to the lamp department, there should be a thorough system of, at least, fortnightly inspection, with reports of trouble and breakage, and their causes.

With careful attention, the expense in the lamp department should not amount to more than 28 per cent. of the operating expenses.

As the cost of installation and attendance is generally borne by those manufacturing light, as all fixtures are usually furnished by them, and as the change in seasons produces but slight variations in operating expenses, it is only fair to ask that the revenue be equally uniform. Hence contracts should be annual; circuits should not be cut for transient business without adequate compensation. This is difficult to fix; but it should be at least one-third more per month than is the yearly rate.

We do not offer this paper as a satisfactory or comprehensive report on operating expenses. Data upon which to found estimates of real value, have not been accessible, owing to an evident reluctance to make them known. The subject is, however, one of the most important that can occupy our attention. Upon it chiefly depends the future spread and financial success of electric lighting. Our business is new, and its operation so different from that of other industries, that we cannot draw largely from their experience. At the same time, the public is no longer so patient of slow and awkward experiments at its expense as it was in the early days of telegraphy. People demand immediate perfection in the thing for which they pay.

It, therefore, behooves each one of our members to give freely and fully of his experience to our common fund of knowledge, that our industry may gain a sure and substantial paying basis in the shortest time possible. We would, therefore, suggest that

a standing committee be appointed to receive statistics in regard to the various operating expenses; that this committee adopt a form of blank analysis to be furnished to each member of the Association, whose personal duty it shall be to fill out such blanks monthly, and forward them to the chairman of the standing committee; and that this committee compile and present to the annual Convention of this Association *general* statements as to the operating expenses of various plants, both arc and incandescent. This information should, of course, be received by the committee in perfect confidence, and should be used only for the benefit of members of the Association.

There are many ways in which our interests might thus be promoted. For instance, it may appear that A, running a 300 light plant, has an expense of 2 cents per lamp per hour in the lamp department (repairs, globes, carbons and attendance); whereas, that of B, with a business of like extent, amounts to 3 or 4 cents; and, in the power department, A may be spending 3 and B but 2 cents per lamp per hour. The chairman would then direct A to confer with B in regard to power, and B to correspond with A in reference to the lamp department.

Unless some such method be adopted, any treatment of the subject will be of little value; while with such a system, reports could not fail of most important beneficial results.

Mr. R. W. Pope: In the paper just read considerable stress was laid on the cost of globes. It was stated at our last Convention that the item of globes for lamps exceeded the cost of the carbons. I would like to inquire from those who may be more familiar with the subject than I am, as to the breaking qualities of these globes. Of course, it is evident that the more globes broken, the better it is for the manufacturer.

The President: I will say to the gentleman that there is a special report to be made on carbons, when the matter will come up in connection with it. You may then be able to get more information. Is there any further discussion on operating expenses?

The President: The next business in order is the paper of Dr. Otto Moses, of New York, on "The Incandescent Light."

Dr. Moses: *Mr. President and Gentlemen of the Convention*—I have not prepared a report on the subject of incandescent lighting, but I would be very glad, in an informal, extemporaneous way, to mention some things which were not embraced in the paper by Mr. Beane, and which probably have not been

given in any publications that have appeared so far. What I propose to give is a little of the inside workings of the incandescent light. I am a great believer in the doctrine our President has announced as the one that should prevail—namely, that we are here for the purpose of giving and receiving information. Ours is not a mutual admiration society; but it is one in which what we have we give; and I come to give that which I hope will be well received, particularly as it is a free gift.

Incandescent lighting, as you know, has been advancing ever since the time of Sir Humphrey Davy in various periods of development. He was really the discoverer of the incandescent light, and he produced some result with it that to-day would be extraordinary if witnessed. For instance, he used batteries of over 1,800 volts intensity. That would produce in carbons of the thickness then used results that would be perfectly overwhelming; and it astonished his audience, one of the most brilliant in England. After Sir Humphrey Davy, Starr commenced his experiments; and had he not died at the early age of 27, it is very likely he would have brought the incandescent light to a point where it would have been ready for adoption when the dynamo machine was invented, at a subsequent date. Then there was another period, that of Bouliguine, Konn, and Lodyguine. They used in St. Petersburg incandescent lamps for actual illumination. One of those gentlemen—I forget which one—was a merchant who was interested in scientific subjects. He devised this lamp, and put it in his store, which brought to him a corresponding increase of business. People from all parts of the country visited him, and his lamp was thought worthy of honorable mention by the French Academy of Sciences. After that Moses Farmer began to work on the incandescent light, and another American—Sawyer. At the same time Swan, in England, appears to have made certain experiments on incandescent lighting in vacuo. But all these experiments were not much in advance of what Sir Humphrey Davy had done fifty years before. In 1865 incandescent lamps had been used for scientific purposes. They had also been used for mining purposes, so M. de Changy says; but we have nothing to substantiate that statement. During the Paris Exposition he had an admirable opportunity to bring his electric light before the world; but he neglected it. I believe there is a legal maxim, that if one neglects a right he forfeits it. At any rate, it was only some time after he brought out a paper in which he claims this thing, and figures the lamps exactly like those now in use. I took occasion to investigate his published claims, and I found, as I say, that they are insubstantial.

After that period we come to the new one. Thomas A. Edison, assisted by a number of co-laborers, took up the subject of

incandescent lighting, and in a couple of years brought it to a state of great development and perfection. Swan again took up the subject which he had neglected for a number of years, and commenced to work in that direction, assisted by several persons. Mr. Crookes also began to study the matter. His previous information, and what he had done for the world, enabled him to do that with the best grace; because, had it not been, I think, for his investigations, incandescent lighting to-day would not have been in the position in which it now is. Mr Crookes, as you know, is a very able scientist, originally a chemist, but a man of multifarious development, scientifically. In 1878 he made an elaborate study of gases in vacuo, and, in connection with a co-laborer, Mr. Gingingham (a glass-blower), did a great deal to render incandescent lighting possible, because all the preliminary facts connected with the study of the vacua were carried by them to a finished point of development. For instance, he was enabled to produce vacua of one two-millionths of an atmosphere. As some one remarked, that is equivalent to saying one one-hundredth of an inch of mercury in a barometric column three miles high. That will give you some idea of the perfection of the vacua that he produced. Contemporaneously with Mr. Crookes, Mr. Gassiot, Mr. Spottiswoode and Mr. De La Rive, all assisted by wealth, carried their investigations to a very high point of refinement. You know Mr. Spottiswoode had an induction coil made that would give a spark forty inches in length, and Mr. De La Rive made use of the most complicated apparatus for producing all degrees of perfection in the vacuum, the eliminating of certain gases, the absorption, for instance, of oxygen and carbonic acid, and all those refinements which are necessary if you wish to study the phenomena in their perfection. After that Mr. Edison commenced his investigations, and still further perfected the mechanical parts of an incandescent lamp. His lamp was at the Paris Exposition, and there found much favor. At the same exposition were the lamps of the United States Company (the Maxim Lamp), and of Mr. Swan and Mr. St. George Lane Fox. However, the incandescent lamp was simply a matter of progressive development. Sir Humphrey Davy showed that it could be produced by the incandescence of small carbon rods made from vegetable fibre in the vacuum of an air-pump. Starr had done the same thing over mercury. Bouliguine, Konn and Lodyguine had done it by the use of stoppers; that is, they had made vacua, and had tried to stop them with cements. At that time Geissler had made his vacuum tubes, in which he had rarified mediums; but his vacua were maintained by the fusing of glass, so that they were practically perfect. And, as an interesting fact, I may say that a vacuum tube was prepared by Prof. Quincke over twenty years

ago, which he has been weighing at intervals since, and it is exactly to-day in the same physical condition in which it was then. It is simply a glass vacuum tube fused off, so that the fused globe having a vacuum inside will absolutely not leak.

Every vacuum tube through which an electric current passes, as prepared to-day, does leak; and it leaks because platinum wire is not glass, and there is an air film between; but that film is so infinitesimally small that probably it would take a hundred years before it would leak—that is, before it would become subject to the same atmospheric pressure that prevailed around it.

To those who desire to take up that subject, or who have been engaged upon it and would like to improve in it, I would say that the opportunities it offers are considerable for the development of incandescent lighting. I would like to call the attention of members of the Convention to particular points capable of development, so that they may work out on those lines—such lines as I myself have selected to follow up. As an exemplification, however, of what an incandescent light is, I have introduced this [exhibiting a lamp] at the request of the President. This is a lamp I have been at work on for several years past, although the principle has been applied by me long before. The lamp as you see it here—any lamp would answer the same purpose—consists of the following organs: A glass globe evacuated, either hermetically sealed by making it a continuous glass globe, or not hermetically sealed, and stopping it. In this case my lamp happens to be stopped with the only material that will not allow of admission of the atmosphere into it; that is, as you are well aware, platinum. The lamp that I have in my hand is a stopper lamp. This stopper is of platinum. And I would like to call your attention to a very remarkable fact, that enables incandescent lighting to be possible, which is this, that platinum and glass have identically the same co-efficient of expansion. That is, if I heat a platinum wire and a glass rod of the same dimensions, and notice the dilatation, I will find they have increased exactly the same in length and the same in width. You put these two substances together, and you have under the applications of heat the same expansions. And here comes another very wonderful thing, for which we should be thankful: It is, that platinum is a very poor conductor of heat; so is glass. If those two substances, having the same co-efficients of expansion, expanded in different times, in different ratios, it would not be possible to unite them together. It is only because they expand in the same ratio that you can apply a surface of platinum to a surface of glass, and get a perfect stopping for a vacuum. I do not know, in the whole range of sciences, where I can point to a fact where so much depends upon one trifling circumstance.

The next organ is the incandescing portion of the circuit which is enclosed in that vacuum. A little recapitulation here

will be necessary. As stated, Sir Humphrey Davy already used carbon for that purpose. But platinum was known, too. All the eudiometers that were used for the explosion of gases in vacuo, in the analysis of gases, contained platinum electrodes. Then platinum was used as an incandescing conductor. In 1864 I had the pleasure, as a student, of making an incandescent lamp consisting of eight incandescent lamps grouped in one fixture. The object of it originally was a purely scientific one, though practical in its bearing. It was to make use of the incandescence of platinum for the purpose of indicating variations of movement. I applied it to an anemometer, and I have the pleasure of saying that it met with the approval of the eminent astronomer, M. Le Verrier, to whom it was shown at the astronomical observatory in Paris. Staite found that iridium was better than platinum in incandescent lamps, for certain purposes. Then came the period of carbon taken up by a triumvirate of Russian physicists; and also improved very much by Mr. Sawyer, who died some years ago; and then further developed by Mr. Edison. It is scarcely necessary to say that almost any organic substance will furnish a carbon that can be used for electric light purposes—all except those that have nitrogen in their composition. It is said that silk may be used for incandescing conductors. Experiments I have made show that silk disintegrates under it and forms flocculent scales. You may change the character of it by eliminating the nitrogen, and it is probable that that has been done by those who may use it. But almost all organic substances will furnish a matter for the incandescing part of the electric light circuit. Carbon, as you are aware, has wonderful electrical properties. It will permit of the passage of currents very easily, and it is very homogeneous; that is, for given lengths it retains its resistance uniformly; but there is this one property that must be called to mind, that by increasing increments of heat in the preparation of the carbon you can diminish its resistance. A metal heated returns to its original resistance approximately, though some of them expand more than others, and do not retain their original diameters, but with a very small degree of variation. You must look to something in the chemical nature of carbon for the cause of its peculiar action. I have examined the spectrum of carbon incandescing loops up to the point where they have disappeared under the influence of powerful currents; that is, they have been volatilized; and I find that invariably hydrogen is present in the spectrum up to the last point of separation. As I said to M. Dumas, the greatest authority on the subject of carbon, "I do not believe that such a thing as pure carbon exists;" and he replied, "I have very grave doubts of it." But carbon, with infinitesimally small proportions of hydrogen, may be called

carbon. The diamond is probably the purest form of carbon that we have; but below the diamond, in the scale of hardness, I think you may say that carbon is almost invariably united with hydrogen, and one or more atoms of hydrogen will continue to go off with every increment of the heat you give it, until the proportions become overwhelmingly carbon and infinitesimally hydrogen; that is to say, you can go on heating carbon, and, in proportion as the hydrogen is driven off, you then acquire more and more peculiar qualities in your carbon. Its resilience diminishes. Its density increases. It becomes gray in color. Finally, it reaches a hardness approaching the diamond; and it is not improbable that the diamond was produced by the elimination of the hydrogen from the carbon by intense heat. All other forms of carbon are amorphous. So much for the carbon filament. The carbon filament has to be maintained in close relation with the rest of the circuit; and various ways have been invented for that. Then, as we proceed further from the incandescent conductor, we come to those parts by which the lamp itself is attached to the main circuit, to the holders, upon which a great deal of inventive ingenuity has been expended. As far as the glass globes are concerned, there may be any variation of forms in their construction. They may be pear-shaped or globular. Glass lends itself to any shape; so that is unessential. But when we come to the vacuum we have something that we have to look at more particularly. A vacuum may be considered as representing so many foot pounds of energy expended. To produce a vacuum you have to lift a column of mercury and allow it to fall. It may be interesting to you to know something connected with the vacuum. I will entirely eliminate from view all the delicate instruments of Crookes, Gassiot, and others, because they are simply intended for scientific purposes, and we will come to the discovery of Mr. Sprengel, which will enable you rapidly to make as perfect a vacuum as Mr. Crookes made. It consists of a simple fall tube of glass, to the upper portion of which is connected the object to be exhausted, and also the reservoir of mercury which is allowed to flow into this tube. Those are the elements. I have made vacua of one-millionth of an atmosphere, and I think you ought not to stop much short of that in producing your vacuum for incandescent lamps. Imperfect vacua have this quality of conducting a wave of heat more readily; so that if you have an imperfect vacuum you will produce much less incandescing of the carbon conductor than you otherwise would. And, if you go on admitting air to your vacuum you will find that, with the same expenditure of foot pounds, you have an enormous loss in light; and, if you go still further, as Grove did more than twenty years ago, and fill your globe with other gases, you will find, if you take, for instance,

hydrogen gas, that it is very difficult to produce any incandescence of the carbon at all, the hydrogen gas serving to conduct away the heat with the greatest rapidity. You cannot get your carbon into incandescence without an enormous increase of energy. Therefore, to return, in order to produce the most economical incandescence we must have our vacuum as perfect as possible. You are all familiar, I suppose, with the manufacture of charcoal. You take an organic substance, exclude it from the air and heat it; the volatile hydro-carbons pass off, and, as you apply your heat more and more you get the desired carbon.

The same thing is carried on with much greater refinement in the manufacture of carbons for incandescent lamps, because you are dealing with things of great tenuity and fragility. They have to be carbonized in certain modes. The carbon I have in my hands shows how remarkable is the plasticity of carbon. I could write my name in carbon if I wished, and then carbonize it, and I would get a diminution in size of the letters, but it would retain its form just as well as if I were writing it in a glass rod. Carbon when heated is plastic, perfectly plastic, and you may form it into knots, but when it is cold it becomes more fragile. It is, however, very elastic when cold. It is possible to insert into a globe a carbon curved into an incomplete circle of very much greater diameter than the orifice through which it was introduced. After all, incandescent lighting points to the use of very long conductors of carbon contained in large globes. It would then be very necessary to put that carbon into such a shape as to diminish the cost of producing your vacuum. Of course, if you can put a greater length of carbon into the same compass it becomes more economical to do so; but if, as has been invariably the case before, you have straight carbons, you must correspondingly increase the length of your globe to such an extent that I have really seen the matter carried to extremes. There is an enormous waste of energy in exhausting those globes. If you could have put that carbon into a much smaller area you would have diminished the vacuum considerably. I think you will admit that getting the carbons into economical areas is a very important point to be considered in the manufacture of incandescent lamps.

As to the attachments of lamps, they are various in their nature, and they are matters of detail upon which I will not enter, because all of you gentlemen, I hope, will look into that subject and present the incandescent-lamp using world with nice appliances. In closing, gentlemen, I will again revert to the fact that I had no intention whatever of speaking on this subject; but only through the kindness of the President was I induced to do so. [Applause].

THE PRESIDENT: Dr. Duncan, chairman of the committee on tests of the life of incandescent lamps, instituted by the Franklin Institute, of Philadelphia, is present, and we would be glad to hear from him on the subject.

DR. DUNCAN: I am utterly unprepared to say anything about it, and my knowledge on the subject is very slight compared with Dr. Moses'. But it is a subject in which I took much interest, and I have had some opportunities to judge of the life and efficiency of the incandescent lamp. I would say, in the first place, that the tendency has been to increase the tension, and, therefore, to decrease the size of the conductors. The cost of incandescent lighting, the great part of it, is in the conductors necessary to carry the very large currents which have been used with the low-tension, and lately a great deal of investigation has been made in the direction of increasing the resistance of the conductors. How far the incandescent light can be developed, and how much it will interfere with arc lighting, of course we cannot tell. Within the last two or three years some parties have been inventing lamps of great power, which it seems possible will still further be developed to the extent of taking a good part of the street lighting. I do not know how far that will go, but there are a good many difficulties in incandescent lamps which are very hard to get rid of. After a lamp has been used for a long time the globe is blackened from the particles of carbon flying against it, and that, of course, decreases the efficiency of the lamp. Another defect is, as Dr. Moses said, a change in the structure of the carbon after it has run for a great many hours. I have examined carbons under a powerful microscope, and find that after a short time these carbons, made of natural fibre, become crystalline in structure, and, finally, after a few more hours, burn out. The most successful carbons so far made seem to be of fibrous material. Any homogeneous carbon has, up to the present, lacked the life element. Carbons that have been made of materials that have not had this fibrous structure have not lasted very

long. But one advantage the incandescent has at present over arc lighting is in the greater possible efficiency of the low potential dynamo. In a dynamo where the potential is not more than 150 volts the losses are very much less, and, therefore, the efficiency is possibly greater. You have a loss due to the induction currents in the armature, but it is less in the low-tension machine, and there is also less possibility of burning out. If you have an arc machine made on the Siemens' plan, where the currents cross each other, there is always this possibility of jarring the insulation when it is run at too great power, but with a low-tension machine, of course, there is much less possibility of that effect. For that reason, it is probably better to have arc machines with the Cramp type, and incandescent machines with the Siemens type. The latter affords some few advantages for mechanical construction. But I am really not prepared to say anything on the subject. Dr. Moses has so fully covered the ground, it seems unnecessary to say any more.

Dr. Moses: I hope the gentleman will not cease his remarks on that ground, because he has had great practical experience.

The President: The Association would be glad to hear from the Doctor as fully as he pleases.

Dr. Duncan: The work done at the Franklin Institute consisted of tests of lamps and of dynamo machines. The lamps were tested for efficiency, and were afterwards tested for life. Some of them lasted beyond the test. The efficiency tests were made with a great deal of care. The results hardly came up to the expectation of a good many people interested in the incandescent lamp. Mr. Preece made the statement when he was last here, that they had lamps in England that would give a candle power for an expenditure of two and a-half volts, and yet have very long life. But we found generally that lamps with the greatest efficiency lasted the shortest time. Lamps of long life run into comparatively low tension. Lamps of low efficiency usually have long life. There were two lamps which

were very irregular. They seemed to be in the experimental stage. They were very efficient, and one of them had very long life, but there were a good many evidences during the tests that it was in a transition state. People are always making changes in the treating of carbons, and in the arrangements of details. In most of the later lamps the carbons are very heavily treated by a hydro-carbon. In one make of lamps we tested, this seemed to be the case. The makers would not tell the process. The result of the test to some extent was unsatisfactory; that is, the test was not long enough to put out all the lamps. The lamps were all put in at about the same potential, so we could not, under the provisions of the code, judge of the variation of the light. As for the tests of dynamos, made after the lamp tests, the only two systems were the Edison and the Weston. They both are built on about the same principle, and both were beautifully finished mechanically. In one machine—a 400 Ampere, weighing about four tons—the armature would go around half a dozen times after starting it. These machines gave a very high efficiency, and showed an almost entire absence of self-induction. There was a very small loss due to the pole pieces, and another due to self-induction. But the machines ran with no sparking at all. We ran them for about ten hours on a full load; and it took at least ten hours to heat them, and sometimes they would continue during the experiment, lasting about five or six hours. But the efficiency on the different loads varied a good deal. It seemed that the loss in horse-power was about constant. Of course, that was a greater percentage of the total power, and the efficiency fell with the small load. But the potential being constant, and the revolutions being the same, the induced currents in the armature and the friction would be the same, and there would be only a difference of self-induction which made the loss constant. But I would say, in arc lighting machines there would be this advantage of having the self-induction very great. In order to get a high tension you must, of course, have a number of windings, and in whatever

way you arrange them you have this effect of self-induction. For that reason, one would suppose the incandescent machine would be preferable. There were some criticisms on the tests about the friction of the armature being very small, but we did not see them until a day or two ago. The machines were coupled directly to the dynamo-meter, and in that way all the weight was taken off the bearings, and, at the same time, the oil was allowed to get all around. There was a pulley on the dynamo-meter which weighed about 100 pounds, the friction of which, obtained after each test, was over a horse-power; while the friction of the dynamo-meter—the armature weighing, perhaps, 1,500 pounds—was only about four-tenths of a horse-power, due to the fact, of course, that the pulley was pulled up against the bearing, which caused this heavy pressure on it, and prevented the oil from getting in there; while, with the armature running with this universal coupling, the oil could get all around it. I think that is about all I can say about tests.

Dr. Moses: Any one in this Convention who has done work that has value is supposed to offer it here, and if Dr. Duncan will allow me to put some questions to him that I know he can answer, it may assist that general object. I will call the attention of the President and the Convention to the fact that I have received a letter from the firm of Woodhouse & Rawson, an English firm of some celebrity in the manufacture of incandescent lamps, in which they have taken exception to certain experiments made at the Franklin Institute, and I would like to have the gentleman take occasion here in some way to formulate his remarks, so as to show the impartiality of those proceedings. The firm say that their lamps were run at a very much higher potential than they were intended to bear. Now, as they have furnished certain figures in connection with their complaint, I would like to know, in justification of the action of the Franklin Institute, what was exactly the nature of the tests with regard to those lamps.

Dr. Duncan: The first lamps of Woodhouse & Rawson that were put into our hands were marked 55

volts, and we tested them at that potential. Afterward another lot of lamps was sent by Mr. Preece to the Edison Company, from whom they were sent to the committee. They were marked 55 volts, but that mark was cancelled and 50 volts put there. The lamps were claimed to be 20-power lamps. We tested them, and they gave only twelve candles, and the efficiency, I think, was one candle to four and a-half volts. It was very evident that the lamps were not intended to run at 50 volts. This efficiency of one candle to four and a-half volts was such as we did not care to publish, because it reflected on incandescent lighting in every way; so we thought it better to put them in at what we knew was the candle-power they were intended for, and try them at that. We considered the matter, and put them in at 55 volts, and the committee did not publish the efficiency tests which were made at 50 volts. The matter, I think, was explained by the Treasurer of the Franklin Institute in one of the electrical papers—I think *The Electrical World.*

MR. MARTIN: I would like to state that *The Electrical World* two weeks ago published a letter from the treasurer of the Franklin Institute, which was also published in the *Journal* of the Franklin Institute, for the current month, meeting all those points raised by Messrs. Woodhouse & Rawson, and answering their letter in a way which, I think, will give them some little satisfaction, but I do not think it is likely their feelings will be altogether smoothed over.

MR. UPTON: It seems to me that almost every one who came out behind in those tests is kicking. Now, I would like to know what lamp did show the most efficiency and lasted the greatest number of hours?

DR. DUNCAN: The lamp that showed the most efficiency did not last the greatest number of hours. The lamp that lasted the greatest number of hours had the least efficiency. The life of the Edison lamp was very satisfactory, but the efficiency was very small. There were two or three lamps that came out very well. I do not like to bring out instances, but if you ask for them

I will give them. The Weston lamps did not come out well. Mr. Weston says there was a mistake, and we were going to test some more, but he did not send them in time for the test. The Hoyt lamp, of Boston, came out very well. The resistance was very remarkable. With the same potential the candle power ran up very fast for the first three or four days, and afterwards ran down; and, on the whole, they were quite satisfactory, although irregular. In fact, all the lamps came out pretty well. But in an article I saw this morning, by Mr. Herring, in some electrical paper, he compared the different kinds of lamps and made a table. I have not tabulated the results at all, and so I cannot speak as to its correctness. But no lamp showed both great efficiency and long life. They seemed to part there.

Dr. Moses: As that is probably one of the most interesting features of incandescent lighting, I would like to emphasize to the Convention that those things are somewhat in the control of the manufacturer. As we heard yesterday, in the discussion on steam engines, there are some cases where it is better to use high or low pressure, fast or slow-running engines, according to the circumstances. The first thing to be considered is that the manufacturer goes in for the object of making money, and the one who produces a lamp with the greatest efficiency and the greatest life does not always make the most money. His lamps have to burn out, or his business would have to stop. Now, lamp manufacturers can make them, in some respects, a great deal better than they do; and when the time comes that people will pay a hundred dollars apiece for lamps that last forever, then will we have lamps of perfect efficiency and economy.

Mr. Upton: The profit seems to be then on the renewal. The report of the Franklin Institute seems to be like those country fairs, where they do not want to hurt anybody's feelings, and so they give everybody a brass medal.

Dr. Duncan: The Franklin Institute did not make any remarks about tests. They simply made the tests, and let the parties do what they chose.

Prof. Rowland was requested by the President to make some remarks to the Convention.

Prof. Rowland: I have just arrived, and have not quite caught the drift of the discussion. I may say, however, that I have always been interested in the subject of electric lighting. I remember that, when a student in Troy, I used to read about that old Wild machine, which was the first of the modern machines, and at that time I constructed an armature which, perhaps, some of you saw at the Philadelphia Exhibition. I was too young then to have it appreciated by my friends, or probably I would have had it patented, and it would, perhaps, have been adding to my funds at this time. But my friends thought it was one of the little toys of my youth, so they let it go. However, I am very well content to be as I am, and to come down here and listen to this discussion. Although I am in the line of theoretical science, I always take a great interest in this subject. When this question of electric lighting came up I made the first measurements of the efficiency of the incandescent lamp. But the subject has got quite beyond me now, and I do not come down here to discuss it at all. I merely come here as a learner. I will be most happy to see any of the gentlemen at the Johns Hopkins University. Although our new laboratory is in process of construction, I shall be happy to show them anything we have there at the present time. I suppose that the apparatus which would principally interest the Association is that made at the Johns Hopkins University some years ago for the determination of the ohm. I may say, that part of it is at Clifton, and part in the city, so that it is scarcely worth looking at at the present time; but I will be happy to show the remains to any of you, and do anything I can for the Association. I am sorry I was prevented by engagements at the University from being here at the first meeting.

Mr. Robinson: [The speaker put a question to Dr. Moses, illustrating it by referring to a lamp, which the reporter could not hear.]

Dr. Moses: That has no effect whatever. In fact, you may reverse the poles a thousand times a second without

producing any very great disintegration on that account. You can use alternating currents on these lamps, as Mr. Siemens has done. Whether a current flows through the conductor in one direction or the other, there is no appreciable difference that can be observed in the conductor. The crystallization, or the arrangement of fibres, does not set in a particular way, that we know of, under the current, so that it would not be essentially affected by a current running in alternating directions; that is to say, that the results would be absolutely the same whether the current came in on the positive or on the negative pole.

Mr. Robinson: And then one other thing I would like to ask. I have an Edison lamp, the holder being entirely covered with insulating material. In that lamp there was a large teaspoonful of water. I placed the lamp in this position [illustrating] for a month. The water was still in there. I turned it in this way [illustrating]. The water was still in there. I put it in a circuit, and got the small arc that we always get from a broken carbon. The water is still in that lamp.

Dr. Moses: Under what conditions did the lamp burn?

Mr. Robinson: The lamp was hung directly from the roof. It is not known that there was any water put in the lamp. I have no means of weighing it, or I should certainly have done so. But from a mark, by holding it up perfectly level, I can see that the water is diminishing. Now, what is the cause of that? If it would be of any use to you to test it, I will send the lamp.

Dr. Moses: That is very kind, but I think it can easily be explained without putting you to the trouble, and as easily as the way in which the apple got into the dumpling was explained to George III. All the outer connections of the Edison lamp are open. Moisture was absorbed by the plaster in such quantity that it became saturated. The water dropped upon the heated portion of glass that carried the incandescent conductor, cracked it, and finally leaked through the

crack. It is only when the glass is cracked that the water can get in. Experiments were made by Captain Tanner, of the United States fish steamer *Albatross*, on the sinking of incandescent lamps to considerable depth—the object being to attract fish to the incandescent lights. He only met with partial success, because none of the globes could stand the pressure at a great depth. But he found that some lamps did leak before they broke. He had lamps made with very thick glass walls, yet such was the result of his observation; so that, I think the same thing would hold there. When you have a comparatively large crack for the water to come in, it gradually is driven in by atmospheric pressure. Recollect that the interior of the globe was in the condition of a vacuum, and when that crack was made the water entered there freely under atmospheric pressure.

MR. HICKEY: I think that it is often possible to make a lamp with an apparently perfect vacuum, and yet there may be a small crack around the platinum which does not show itself until some time after the lamp has been made. I had four or five lamps which, after being sealed in the sockets, I found had water on the inside, which could have come there only through the plaster of Paris. One thing more I should like to mention, and that is the shrinking of carbons. Have you ever noticed the difference in the resistance of carbons when at different temperatures? I have found that treating a carbon of seven or eight thousand ohms with hydro-carbon at a very high temperature, it will burn at 150 volts. If I do not roast my carbon to such a high state of incandescence it will still give the same resistance, but require only 100 volts to bring it to the same candle power. Upon examining the carbons with a microscope, I find that one is very hard; the other is very much thicker, and yet gives the same resistance as if the two were the same, the electro-motive force required being entirely different.

DR. MOSES: The reason of that is that when you are treating a carbon with a hydro-carbon gas you do not know exactly what you are treating it with, unless you

know exactly the temperature of the gas while it is passing in contact with the incandescent carbon. You are aware that all hydro-carbons are of definite composition, and have different proportions of carbon and hydrogen in them. The higher the temperature to which the hydro-carbon is submitted the more carbon remains behind. Those who are acquainted with petroleum manufacture are aware that there is a residuum left after distillation, and you may carry that thing, as I mentioned to M. Dumas, to an extreme, to a point where the carbon filament will not stand any more heat; that is, to a temperature where an ordinary incandescent lamp, intended to give 16 candles, will come up to 150 or 200 candle power, and then there is a disruption of the carbon. I am safe, I think, in assuming that there is no carbon, with the exception, perhaps, of the diamond, that does not contain hydrogen in it. Now, as you heat your gas you are driving off more and more volatile properties, so that you gradually reach a point where there is a great deal more carbon in the gas than there is hydrogen. The highly-heated gases I speak of deposit a more dense carbon on that account.

MR. SMITH: I would like to ask Dr. Moses whether the life of an incandescent lamp run on an arc circuit from a high potential, is necessarily shorter than the light of one run from an incandescent machine; and if so, why?

DR. MOSES: Incandescent lamps to be run successfully should be run at uniform potentials. A lamp can only bear a certain amount of current. For that it is calculated, and, at that it should be invariably run. If a man has regular habits, goes to bed at nine, gets up at seven, and does not have any moral, religious or political troubles, he will live a very long time; so with an incandescent lamp. If you observe incandescent lamps on arc light circuits you will find them occasionally running at a much higher electro-motive force than they ought to run. The very subject just debated, of the deposition of carbon at high temperatures, can be brought to apply here. You heat the

carbon to a much higher temperature than it is intended to bear, to a point at which it loses some of its hydro-carbon substance. Then it becomes less in resistance. There is more current passes at that point, and in that way you disintegrate the lamp and destroy it. If you can afford to have an apparatus such as that seen last evening in the President's rooms, which is an arrangement of incandescent lamps on an arc light circuit, by throwing in corresponding resistance in case of the destruction of one of those lamps, you can compensate for it, and keep the remaining lamps at a constant electro-motive force. In that way it is possible to run incandescent lamps in arc light circuits. I would like to call the attention of the members to that apparatus up-stairs. It is made by an ingenious young man, Mr. Brown, and has some meritorious points about it.

Mr. Smith: My difficulty is this: I am running incandescent lights on an arc light circuit. They are controlled by a Brush automatic cut-off, which is very efficient, so far as it goes. The current is so steady that you cannot see by the eye that there is any difference in the lamps. What I want to know is this: Is there something in the nature of the high potential current which destroys the lamp sooner than in the low potential current. I think that the objection you raise is easily understood, but in our case it does not apply, because the lamp does not flicker. If one breaks, the cut-off goes into operation. I cannot see anything else in it so far as the nature of the unsteadiness of the current is concerned. There must be something more besides that.

Dr. Moses: I presume that is due to the fact that there is a greater pitch to the electrical wave, if I may be permitted to use that expression. If you are using a current of high electro-motive force your carbons become highly incandescent, and there are variations imperceptible to the eye. But, that those changes take place, I think is theoretically quite possible. The carbon is in a plastic condition, and is heated to an enormously high temperature. It is in vacuo; con-

sequently the radiations are not so rapid, and any changes of the kind, I think, would not be so very serious, because the temperature of the carbons would not change rapidly enough during the intervals in those operations to bring about a disintegrating effect. It is a curious phenomenon. It takes time, however, to discuss it. Is it your experience that those lamps do not last as long as those that run on lower potential machines?

MR. SMITH: Yes, sir. My experience in incandescent lighting on arc light circuits has not been a profitable one. In one case we burned out fourteen lamps at a dollar apiece in one month, where our income from those lamps was six dollars a month.

DR. MOSES: At the last meeting I called attention to the fact that I did not think that up to that time there had been a sufficient advance made to induce people to introduce incandescent lights on arc light circuits. I deprecated it because the arc had not been sufficiently studied in connection with incandescent parts of the circuit. You are dealing with very high potential currents, and you are using very delicate bridges to carry them; and why should you charge the whole of your variable current through those small bridges if you can get light economically in any other way? I think it injures both the arc and the incandescent light business to do it. Anything that prevents the light from being constant is doing an injury to our electric light interests. A very slight shock can paralyze an incandescent light. You should not take so delicate a piece of apparatus as that and put it on a current of such enormous proportions, unless you have a perfect regulating machine to control it.

THE PRESIDENT: Mr. Swift, of the Brush Electric Light Company of Cleveland, is present, and I think that company is the one which inaugurated the system of putting incandescent and arc lights on the same circuit. Perhaps he can answer the gentleman's question. Mr. Smith, of Jamestown, N. Y., asks for reasons why incandescent lamps on an arc circuit burn out far more rapidly than those on a circuit run from an

incandescent machine. He also makes the statement that in one case where the income was six dollars a month he burned out fourteen lamps at a dollar apiece; and so he thinks that there must be something radically wrong which may possibly be remedied.

Mr. Swift: The company that I am connected with does not furnish the lamps. I must refer you to the Swan Lamp Manufacturing Company.

Mr. De Camp: I wish I could get out of my scrapes as easily as that.

The President: That is true, and sounds very well to the gentlemen present who are not of the subordinate companies of the Brush. The officers of the Swan are the officers of the Brush Company. The Swan is in the Brush manufactory. The difference between the Brush and Swan Company in Cleveland, according to my observation, is a partition of pine boards an inch thick.

Mr. Swift: In reference to what you state, I will say that the main point is that it lacks the elements of truth. The officers of the Brush Company and the Swan are not the same. Mr. Stockley, who was manager of the Brush Company, is not even a director of the Swan, and I am not even a director or a stockholder of the Swan, so I cannot be expected to answer the question.

The President: I only want to add here that all the orders that go from our company for Swan lamps go to Mr. Swift.

Mr. Ralph W. Pope: Can the Brush Company get any other kind of lamps than the Swan lamps?

The President: No, sir; you must always apply to the home company.

Mr. Swift: If you send the order to the Brush Company they will receive it as a matter of courtesy to you and turn it over to the Swan Company.

Mr. Smith: I think I ought to say that the lamps vary greatly in quality. Some of the first lamps we got lasted much longer. I do not think it is due to inequality of the action of the machine. I should say in fairness to Mr. Swift, that there is no fault to find in the current of the machine. The cushioning arrangement of the machine certainly does keep the

current steady. If it lags a little in action the man assists it.

Dr. Moses: I would like to mention to the gentleman that, according to the highest authority (Professor Helmholtz), the eye is a very imperfect instrument; and, in the second place, if you wish to see how quiet and calm the effects of a disrupted current may appear to be to the eye, take a Geisler tube and you will see striæ absolutely motionless, and yet we know that the current is being disrupted hundreds of times a second; so that the eye is not an instrument to be used as a photometer.

Mr. Smith: Is not the ampere meter reliable?

Dr. Moses: Not at all. It cannot begin to register those variations of current. The inertia of the needle is such that it may be acted upon a hundred times before it will move once.

Mr. Smith: The ampere meter that I have is a very crude affair, but the needle is in a state of tremor all the time.

Dr. Moses: I am quite sure that we could receive considerable instruction and delectation from Professor Rowland on this very subject, if he would give the Convention some account of the methods he employs for registering variations in currents. In the course of his very extensive theoretical investigations he must have used the most delicate apparatus for it.

The President: I would like to ask Dr. Moses and Prof. Rowland whether they agree with the statements made by Dr. Duncan, that all lamps come under one rule—namely, that a lamp by whatever it is increased in efficiency is diminished in light?

Prof. Rowland: I did not hear the question.

The President: Dr. Duncan makes the statement that where a high efficiency is attained it is at the expense of the life of the lamp.

Prof. Rowland: The theoretical efficiency of a lamp depends only on the temperature. It makes no difference what the shape of the carbon is or anything of that sort. It merely depends on the temperature to which the lamp is heated. For instance, you can very

readily, from the distribution of heat in the solar spectrum, determine what the efficiency of a lamp heated to the temperature of the sun would be. I have done that. I have not the figures here now. I calculated it at one time and it came out a very high efficiency, indeed; because when the current passes through the carbon the heat is generated in proportion to the energy of the current. That heat is radiated in the form of both light and radiant heat, and the greater the proportion of light the more efficient the lamp. Therefore, the higher the temperature, the more efficient the lamp; and, so far as that goes, it makes no difference whatever with regard to the kind of lamp; it only depends on the temperature of the carbon. At the same time, it is possible with some other substances besides carbon to radiate more light in proportion to the heat. I cannot say but that by coating the carbon of the incandescent lamp with some substance—I would not be able to suggest what it should be—it may be found by experiment that the efficiency of the lamp would be increased. I know of no such substance. I do not know any substance which becomes red hot sooner than another substance. In ordinary physics it is stated they all become red hot at the same time. If that is so, it is to be supposed that the proportion of radiant light and heat would be about the same, and the efficiency of the lamp would only depend on the temperature. But I think very likely you might find some substances which, by coating the carbon with them, you might get more light.

MR. UPTON: I am not an electrician. I am glad I am not. But I had a little experience in Washington looking at these things. I have yet to find any success financially in any incandescent lights running off arc light circuits. I talked with both the Brush and Thomson-Houston people. The latter are now getting out an independent machine to run at low potential. I think the universal opinion through New England is that incandescent lights off arc light circuits are a failure.

DR. MOSES: It has been suggested to me that this question we are considering is largely a commercial

one. The Professor has kindly undertaken to look at it from the theoretical standpoint that underlies it all. Yet, at the same time, it seems to me, he assumes that he is using a perfectly homogeneous conductor; but we know practically that all the different materials used in the manufacture of incandescent light carbons vary in their tensile strength, and in the diameter of the fibres of which they are composed, all of which are things that concern the economy of the lamp from a commercial point of view. So, if he would allow me to supplement what he has said by an illustration, I think his remarks will enter as deeply as they ought to enter into the minds of members of the Convention. If you obtain a bamboo fibre—the substance of which Edison makes his lamps—and examine a cross section of it under the microscope, you will find that it has, say, ten fibres. In the manufacture of the incandescent lamp one is liable to divide the fibres, because they are not parallel. Now, if in the process of dividing those fibres, you cut some of them, you discover that the resistance of that particular lamp varies from the normal. It is very reasonable, too. Just imagine the fibres to be ten wires joined together. In the process of shearing you may cut one of those wires, and you have only nine little wires left; and so on. When, in order to increase the commercial efficiency of the lamp, you have brought the fibre down to still smaller dimensions, you may have there only five or six wires to conduct the current. You have diminished it by one-half, to be sure, but you may have also unavoidably cut one of the remaining fibres. That relation, in the first case, is as one to ten; in the second case, as one to five; so that mechanical difficulties have to be overcome when you are increasing the efficiency of the lamp by diminishing the diameter of the conductor. I simply say this to explain Prof. Rowland's remarks, so that they may not lead us to think it is simply a question of temperature. He is perfectly correct in what he says when he assumes a perfectly homogeneous conductor.

Prof. Rowland: I was not speaking with regard to the life of the lamp. I was speaking with respect to

the amount of light we are getting from a certain amount of electrical energy, and my remarks were perfectly exact with regard to that. Of course, the question with practical men is to find an element that will stand the highest temperature for the longest time. That will be the solution of the problem.

THE PRESIDENT: That is the question I asked. By as much as you add to the efficiency of the lamp you decrease the duration.

PROF. ROWLAND: That would naturally be so; because if the efficiency is higher the higher the temperature, and, of course, the carbons will not stand it. It stands a low temperature very well; and the higher the temperature the less it will stand; so that in all cases the higher the efficiency the less time the lamp will last. At the same time, of course, one cannot say that a paper carbon would last longer or shorter than a bamboo carbon. I suppose it is a question of experiment which of those carbons would last the longer. I think that the true method would be to test with a lamp, so as to find out which had the most efficiency and lasted the longest; because if they have the same efficiency, they have practically the same temperature. That would give you the lamp which is the best commercially.

MR. RIDLON: I would like to ask the gentleman one question. I have noticed that some incandescent lamps go out instantly when the carbon is destroyed; in others the lamp is blackened up. Is one kind of carbon more apt to do that than another?

PROF. ROWLAND: I think that it would depend very decidedly on the kind of carbon. Carbon varies so much from the soft charcoal down to the diamond, that it would depend upon the degree of hardness, or, possibly, the amount of gas that remains in the globe. That evidently plays a very important part in the life of a lamp.

MR. RIDLON: I have noticed in an Edison lamp particularly that it blackens up for some time before the carbon is destroyed.

PROF. ROWLAND: That, I understand, is one of the practical disadvantages of all these lamps. It may possibly be gotten rid of at some time.

MR. KERR: I am not a light-maker or an electrician; but there is something that has come up here that is very interesting to me. As I understand it, it is stated that the life of an incandescent lamp, provided the carbon is homogeneous, is chiefly proportioned to its temperature.

PROF. ROWLAND: Well, I suppose that the temperature of the fibre would not be the same everywhere if it was not homogeneous.

MR. KERR: The point I wish to make is simply this: If, as we go on increasing our temperatures in carbon, we find we are getting a shorter durability of this carbon, suppose we increase it 2,000 degrees, does that establish the law that if we increase it to 3,000 degrees it would be still less durable? I wish to state a fact concerning the process of steel manufacture. In the casting of steel ingots it is necessary to use white hot charcoal to prevent the sinking of the ingot. Charcoal heated to absolute whiteness is put into a graphite crucible and hermetically sealed, and when that is heated you can kick the cover off and turn it over like white hot sand. Now, I was at a steel manufactory one day when there had just been an accident. They had turned a graphite crucible and knocked off the cover, injuring two men. The carbon in the crucible seemed to go out instantly. It was heated to 1,200 or 1,500 degrees. That is about a good redness, I believe. Increased to 3,000 degrees, the carbon will not ignite with air. Now, it is not fair to assume that carbon heated to an enormous temperature is necessarily more combustible; because there is the case where the softest carbon we have at a very high temperature does not combine with air. Consequently, I will not admit that the life of a lamp is decreased by raising the temperature beyond a certain point. The probability is, that we have another outgrowth of carbon at that point.

PROF. ROWLAND: I would like to inquire how he got the carbon to that temperature. I supposed that heat is generally produced by the burning of carbon, or, perhaps, of gas.

Mr. Kerr: You simply wish to know how we get the carbon heated. In the steel furnace it is simply put in a graphite crucible; I am not saying anything definite about temperatures; I am only assuming certain temperatures. It is white heat, however, and, as I understand it, that is about 2,500 degrees.

Prof. Rowland: I do not suppose that is a point in electric lighting, because it is a fact, I understand, that the higher the wires are heated the less time they last. I suppose it is an accepted fact in electric lighting, that the higher the temperature of the carbon the less time the lamp will last.

The President: I think this is what Mr. Kerr is driving at. Mr. Kerr means to say that when the pulverized charcoal is brought to a red heat, and the crucible opened, the carbon passes off in the dust.

Mr. Kerr: It just ignites with the air.

The President: Just goes off the same as a filament in a lamp. Now, when a greater heat has been reached, instead of it passing away, you can take a spoon and handle it, and no perceptible change will take place. The inference is drawn that it may be a mistake that it is the extreme heat which produces the greater efficiency of the lamp.

Mr. Kerr: Yes, sir; that is it exactly.

Dr. Duncan: I said that with the lamps we tested, those of the greatest efficiency had the shortest life; but if that were generally true, then there would be an end to improvements in incandescent lights, because you would have to sacrifice one or the other. With the same lamp, the life depends entirely on the current used; and the light increases very rapidly as you increase the current. As far as different kinds of carbon go, if you increase their temperature they have to go through the form when they become crystalline; and at that point they will give way.

Mr. Woodbury: In regard to the difference of the structure of carbon at very high temperatures, Mr. Edison made some investigations by putting a screen in the middle of the horseshoe of the Edison lamp. Where the current was running through the filament,

he noted the deflections of a galvanometer, showing the difference of an electrical connection between one of the wires to the lamp and the wire from the platinum screen in the middle of the lamp. He then increased the current with increments, until the lamp got up to something like 30-candle power, when the deflection diminished, seeming to be a reversed condition. Mr. Edison, at the time of showing it to me, advanced the hypothesis, that it was quite probably due to the fact of the carbon changing in that temperature from an electro-positive to an electro-negative substance. In regard to the question of the plastic state of the carbon in the crucible, is it possible it was heated up beyond the point of temperature of dissociation? Was it heated by a gas flame containing a great deal of hydrogen, and, therefore, hotter than the carbon?

Mr. Kerr: If you stop the carbon during this process of heating at any time before it gets to a certain temperature, which I will call 2,000 degrees, no one particle seems to wait for another. But when you have it all heated and then cool it down, it will cool down past that point and not make any fuss about it at all. There is this, however, to be noticed in that white hot carbon: As you look at it in the crucible, every little while one small particle will ignite, and you will see a spark that will go about twelve inches. Wait a little longer, and you will see a slight flickering from the top, as if something else than carbon was being consumed. But the body of it is all there.

Dr. Moses: This is an exceedingly interesting discussion, because, in a collateral way, is demonstrated the fact, that if carbon be heated it diminishes in proportion to the heat according to a regular increment. The ordinary carbons, such are used in incandescent lamps, shrink about one-third of their length. Now, it may be that you have discovered in another way, and in that way explained, a fact that we have observed in the manufacture of incandescent lights. When carbons have been heated in a lamp to an exceedingly high temperature, the lamp is broken; and if the

carbon be ignited in air in a gas flame, you will find that it takes a much longer time for that carbon to consume than it would have done before. This, I think, explains the phenomenon referred to by Mr. Kerr. While carbon is in an organic condition, naturally the particles of carbon are very far apart. The cell walls are separated a relatively considerable distance, but by the contraction of the carbon in the act of making the carbon for the lamp, the carbon draws together, the cell walls getting more and more approximated. This hypothesis may account for the capacity of carbon to absorb gases, ceasing as the particles get closer to each other. You know that carbon will absorb many times its bulk of different gases. Of ammonia gas, I think it will absorb forty times its bulk. This quality of carbon is observed in the manufacture of incandescent lamps during the process of evacuation. It is not impossible that in the last high heats of the manufacture, you have so approximated the ultimate molecules of carbon that gases will no longer be absorbed. Under this process it may have become a molten mass.

PROF. ROWLAND: Mr. President, when I spoke first I did not exactly understand the experiment, but I understand it now, I think. I am not a chemist, but I believe there are three forms of carbon—the ordinary charcoal form, the graphite form, and the diamond; and when one heats the ordinary carbon at ordinary temperature, it is different from other elements in its specific heat. But when it is heated up to a very high temperature, it commences more and more to obey that law; and, therefore, there is a very marked change at that high temperature in the carbon. I do not know what bearing this has on the life of a lamp, because I do not know which form of carbon would last the longest; but still it must have some bearing.

MR. SMITH: I would not like my experience to deter any members of the Association from trying incandescent lighting on arc circuits. I believe it is an exception, and I believe it is caused by a bad lot of lamps. I believe that that system of lighting can be

made commercially profitable. The quality of the light is there. It is just as good as an incandescent light from an incandescent machine. I believe the lamp-makers will soon get a lamp which will stand the current. A gentleman tells me he has 150 lamps working on that system, and that they are working very well. So, do not go away with tha idea that it cannot be done.

MR. DE CAMP: I think that this question of incandescent lighting on arc circuits is one of the crazes we must submit to. It is new; and no electric lighting company can speak, except from a very short experience. It is a sad one from all that I hear of it. It is so with me. It results in this: that it is going to make a very lively business for the lamp manufacturers. The gentleman raises a question as to the breakage. I wanted to ask Dr. Moses (but I did not care to interrupt him) what would be the difference in the potential of an arc machine by increasing the revolution, say, three, four or five in the armatures; or what would be the effect of an increase of, say, ten volts on a group of lamps on a circuit, so far as potential is concerned? We group our lamps according to the current of our machines. We do know that in a group, say, of seven ——

THE PRESIDENT: One moment, Mr. De Camp. To make that plain, the machine which Mr. De Camp uses is the 26-inch armature new type of Brush machine, and upon that armature an increase in the number of revolutions operates to produce a much more marked result than in one of a smaller diameter.

MR. DE CAMP: If we have one lamp out of a group of seven that goes out from any cause, the others brighten up away beyond their normal condition and we must get something in as quickly as possible to take the place of the exhausted lamp. That is easily done on account of the comparatively perfect operation of the cut-out that we use. But if we strike off two or three of them the rest will go out instantaneously. Now this is, no doubt, due to the fact that we are driving through the remaining lamps

the full force of our current. I do not think that anybody can question that. It is easily demonstrated on our circuits. But to run a dynamo machine for a number of hours without having a change of, say, twenty volts, in its electro-motive force, by the increased or decreased speed of your engine—now I would like to know what difference twenty volts above the normal condition of the machine would make on that series of lamps?—Do I make myself clear?

PROF. MOSES: You will have to eliminate a great many factors in that problem in order to give an approximative answer. You must entirely eliminate the internal resistance of the machine and the resistance of the line and simply deal with the resistance of the lamps. Then you have a definite electro-motive force between the terminals of each lamp. If you intercalate any arrangement of incandescent lights, you will find between the terminals including them the same electro-motive force as you have around each arc light. Any change in the electro-motive force of the series would produce a correspondingly large change of electro-motive force just at that point, and you would get a correspondingly larger amount of current by the breaking of any one of these bridges for the passage of the current through the incandescent lamp arrangement. If you employ slender filaments, you have to put in a sufficiently large number to furnish transportation for the current. If you overcrowd your cars, you are bound to have accidents. Your difficulty is, that you break some of the indispensable avenues for the passage of the current. If you diminish the resistance of these bridges, you will throw such an enormous amount of work on the fibres that they will not stand it. To obviate that you must intercalate some independent resistance which will be thrown into action by the breakage of one of these girders; otherwise your current will put an end to itself in a very few minutes by the disruption of all the carbon avenues.

MR. DE CAMP: That is my idea about it; and I do not think we are yet able to run a dynamo machine

with such absolute perfection that, with the best form of cut-out that can be put on, it can act quickly enough to protect the lamps against that instantaneous action which must take place when one goes out. I do not believe that can be done. It is a scientific point, and it is Greek to me.

The incandescent light is popular. It is growing in popularity. It is most popular among the business people. For certain purposes the arc light suits them; they have no objection to it. There are certain places where they have gas, and where they have no earthly use for an arc light. The distribution of the light to their offices is a great advantage to them. Its freedom from heat is taken into consideration, and they are pleased with it. But, like everybody else who gets hold of a new thing, and who is highly pleased with it, they don't think much at the time of the expense; but when the novelty has worn off I contend that the public will not pay the price that we have to charge for it, if we are going to get a profit out of it. I will explain myself in this way: After the romance and novelty of the incandescent light has worn off, it is simply a substitute for gas light. Now, at present, the price of gas as compared with the incandescent light, is very much less. But I think the people would be willing to pay a reasonable increase over gas. It takes, for instance, precisely the same amount of power to run seven, eight or ten incandescent lights of fifteen or sixteen candle-power as it does to run one arc light. Presumably, you have a compensation in favor of the incandescent light—the saving in carbon and the saving in attendance. That is simply a presumption, so far as our own experience and that of every one to whom I have spoken in this Convention on this subject go. Thus far the attendance on a group of incandescent lights has been more than on arc lights, because of the constant breaking of lamps and their renewal. My own experience as to the breakage on those lamps corresponds very much with Mr. Smith's. But I do not believe that we have got to a point of perfection where the cost of lamps in incandescent groups will not be

very much greater than the cost of carbon in an arc lamp, and the attendance on that lamp for trimming and keeping it. Now, when the novelty of this light is worn off, and we say to these people our charge for a group is the same precisely as for one arc light—we may go farther and say we will make it less—they will pay it but for a short time. The proper way to do this is, to provide that the user of a lamp shall make his own renewals. We did not do it, for the reason that it was an experiment. I realize the evil that there is a craze on this subject; but we must simply accede to the public demand. I had those lights put in, believing that there was no profit in it to us; but I thought it would probably be a cheap way of getting experience. That little installation was entirely in our hands, and so understood by the parties using it. We agreed to make renewals. It was an expensive job. The proper way would have been to require the user of the light to pay for the renewal of his lamps.

Mr. H. W. Pope: I have in mind an experiment I tried in Brooklyn. I inserted an adjustable resistance in the main arc circuit, and from that I ran a shunt wire from which I connected my incandescent light to the arc, taking the incandescent lights entirely out of the arc circuits—that is to say, it would shunt the current and allow only a portion of it to get into the incandescent lights. It seems to me that the life of an incandescent lamp connected that way would be much greater.

Dr. Moses: It is well that this very interesting subject should be thoroughly investigated here; because, I think, it is a matter of mutual interest to the manufacturer of incandescent lamps and to the consumer—that is, either the actual consumer or the arc light companies. I think if it were possible to introduce the incandescent light on arc light circuits it would enormously increase the volume of business done by the electric light companies; therefore, I think, it is a thing of vital importance to determine whether it is possible to introduce incandescent lights on arc light circuits. Mr. De Camp says that the consumer should

supply his lamp. Let us briefly consider some of the difficulties in the way of that. The consumer must get lamps of a certain electro-motive force. He buys them from the company who may or may not guarantee them. He puts them in a circuit, and his lamps may be destroyed. Therefore it is, for the present, to the interests of the arc light company to supply those lamps, and in that way to avoid the difficulty. However, let us assume (because I think it is very near a solution) that the problem has been solved, and that you can safely put incandescent lights on arc light circuits. Let us consider what the cost of an incandescent lamp is, roughly assuming that it will burn a thousand hours at a cost of one dollar, which will make the cost of an incandescent lamp one mill per hour. If you gentlemen will make memoranda as I proceed, and figure out afterwards, it may lead to some interesting results. You are willing to make a reduction, as I understand, in the cost of your electric light in order to avoid the superintendence.

THE PRESIDENT: One word there; a remark which you did not hear comes in. One mill per hour, provided the lamp lasts a thousand hours?

PROF. MOSES: Yes.

THE PRESIDENT: The life of a lamp, Mr. Smith claims, is not a thousand hours.

DR. MOSES: But I assume it to be so. I ask the privilege of assuming. I think it is reasonable to do so, because if it be possible to keep the electro-motive force of an arc light circuit constant, it is possible to avoid all the disruptions that come from variations in electro-motive force. A thousand-hour life is, or will soon be, the guarantee of the Edison Company; and they sell their lamps at eighty-five cents to isolated consumers. I have supposed a dollar to be the cost, in order to give one mill as a basis for rapid calculation. Now, the cost of the incandescent lamp for renewals is one mill per hour. May I ask Mr. Weeks, at this point, what is the cost—I think you said seven per cent., Mr. Weeks—of supplying carbon to an arc lamp? What is the cost of maintenance and attendance and putting in of carbons?

MR. WEEKS: No, sir; twenty-eight per cent. is the total cost of carbons and globes.

MR. DE CAMP: You are speaking now of the cost of carbon alone?

DR. MOSES: No; the cost of maintaining that light in a state of efficiency. The cost of carbons, globes, etc., have to be eliminated, in case you have an incandescent light—twenty-eight per cent. on the cost of maintaining an arc light. If, for instance, to make the calculation more complete, you charge eighty cents for the use of an arc light per diem, at what would you be able to afford to supply that arc light in case you were not called upon to maintain it?

MR. DE CAMP: Aside from the carbons used in an arc lamp, the cost of attendance on it, the extraordinary repairs to the lamp by occasional burning out, and the rest of the expense on the group, would be the cost.

MR. COOPER: I wish Dr. Moses would take that at twenty-five per cent.

DR. MOSES: Assuming that eighty cents is the cost of an arc light per diem, and that you save twenty-five per cent., that would reduce the price to about sixty cents per diem. Now, will some gentleman inform me how long an arc light will burn under those circumstances?

MR. DE CAMP: I think about eleven hours and a-half.

DR. MOSES: Eleven hours and a-half for forty cents. That is about three cents and a-half, then, per hour, as the cost of an arc light. You would be receiving three cents and a-half per hour for your arc light if your consumer were to take it and burn it for eleven hours and a-half. Therefore, the light he would obtain should cost him three cents and a-half. Now, that is a pivotal point. Therefore, three and a-half cents an hour should then be the cost to the consumer of maintaining about eight incandescent lamps of sixteen candle power each. Three and a-half cents for a group of eight—let me say four cents; four cents as the cost of eight lamps burning eleven hours and a-half.

Mr. De Camp: I think I will ask you a question, if you will allow me. Eleven hours and a-half, which would make forty-four cents for these lights ——

Dr. Moses: I beg pardon for interrupting you there, because you are willing to take off twenty-five per cent., for you would then be makiug the same profit and would have no trouble.

Mr. De Camp: Take off the twenty-five per cent. for that.

Dr. Moses: You would be enabled to receive sixty cents by supplying the lamp to a consumer.

Mr. De Camp: It is four cents an hour for a group of eight, and we run eleven hours. That would be forty-four cents. That would be on an even basis with an arc plant.

Dr. Moses: Now, you have eight lamps for four cents per hour.

Mr. De Camp: Figure that up at $1.50 a thousand.

Dr. Moses: Seventy-five cents is the cost of gas to the consumer for this amount of light, and he is getting the equivalent of it in incandescent light for sixty cents. Now add to this one mill per hour per lamp, which is ten cents. Ten cents and sixty cents is seventy cents. He would be getting for seventy cents an incandescent light, while he would have to pay seventy-five cents for the same amount of light from gas. Now, gentlemen, I hope you will preserve those figures, so that you may go over them yourselves.

Mr. De Camp: I am not taking this on the limited number of cases where that business would be demanded and where people would pay the price which might be profitable to us. That is the case ——

Dr. Moses: And here is the difficulty that compels the consumer to use those incandescent lights all the time. Now, then, how many stores and places are there where you can use groups of eight?

Mr. De Camp: I do not think there are many. I think the business is a very limited one, indeed. You can sit down and convince a man that it is the cheapest light in the world, but after a while the novelty gets worn off. He admits what you say, but he says: "You have given me more light than I want."

DR. MOSES: You would like to reach the point where you can supply the light as long as the consumer wants it, and no more, and from arc light circuits?

MR. DE CAMP: If we could run directly, as a gentleman here said to me, with each lamp having its own resistance. I like that sort of business first rate, if we can get it in such a shape that the less we use the bigger our bills will be. That, I conceive, would open a big field to the business.

DR. MOSES: It may be possible to construct so many incandescent lights that some day we may include forty or fifty houses in one series with a proper automatic arrangement. But until those arrangements are perfected, we cannot put a series of incandescent lights through a variety of houses.

THE PRESIDENT: The time is passed now for the discussion of this subject. Mr. Ridlon will read a paper on "Carbons and Globes."

MR. RIDLON: The following is suggested as a perfectly fair carbon test: Take a dynamo machine, with its full complement of lamps, and trim the lamps with the same make of carbons; note the speed of the dynamo carefully, and during the test measure the current at frequent intervals with an ampere meter; see that all the lamps burn freely, without hissing, and yet not with so long arcs as to flame. Measure the E. M. F. around each arc with a volt meter. Burn the lamps until all the carbons are consumed, or burn them, say, for four hours, and then measure the length of carbons consumed, and calculate the total time that they would burn, taking the average result.

In testing another make of carbon, pursue the same course. You will now be able to note the difference between various grades of carbons. Some carbons will be soft, and will consume so rapidly as to make them expensive; others will be of such high resistance that the machine will not run its full complement of lamps with good, long arcs, without increasing its speed. In such a case a lamp or two could be cut out of the circuit until the arcs are normal; and this would show the degree of economy of the first carbons over the others. It is not infrequently the custom to mix several different brands of carbons on the same circuit of lamps, and then judge of the results entirely by the length of time each carbon burns. Nothing could be farther from a real test. A carbon which would burn nine hours would frequently be less economical than a carbon burning eight hours; as generally the latter carbon would enable you to burn, say,

two more lamps on a 30-light circuit than the former. Calculating the rental receipts from these two lamps, it would be found that they would more than make up the difference due to the more rapid consumption of the eight-hour carbons.

The reason for measurements of current and E. M. F. is obvious, as the resistance of the carbons will affect both. With the dynamo machine running at the same speed, one carbon will give you good, steady arcs of, say, 45 volts each, while another carbon will, perhaps, cut down the E. M. F. to 42 volts, and the lamp will hiss and sputter

In any case, it would not be a fair test to trim part of the lamps of the circuit with one carbon, and part with another, unless it were previously determined that the two brands of carbons are of about the same resistance.

MR. RIDLON: I have sent to every prominent electric lighting company for recommendations in regard to tests of carbon, and have not been able to get any positive facts or statements from any of them. I had to go to work and make up this statement from such raw and crude materials as I could pick up myself, and I would be very glad to have the question fully discussed by the superintendents and general managers of the electric lighting companies themselves. They, of course, all have different machines, giving different amperes of current, and they certainly would require different tests for their apparatus to make it perfectly satisfactory to them. The whole question seems to come down to this: That, in purchasing our carbons, we should get a steady average quality of carbon, and all we buy, whether ten, twenty or thirty thousand pounds. I think that the greatest trouble experienced in the matter of carbons, is due to inattention in the sorting by carbon manufacturers. They employ the cheapest class of labor in their manufacture, simply boys and girls; and assort them with the idea that straight carbons should be classed as firsts and the rest as seconds. It does not seem to me that this is the kind of assorting of carbons that we require. We want to be sure that all the carbons we purchase at a given price possess all the requisite qualities—no soft spots in them and an average amount of resistance, in order to get our full complement of

lamps, giving the proper amount of candle power. I suggest that these seconds be cut down to such a price that in making our contract it will be quite an object to send carbons that are all of the first quality and no seconds; and if seconds are mixed up with them, that the price be reduced for the second quality of carbon. They then will pay a good price for labor, and get competent persons to do the assorting. I will be very glad to hear from the carbon-men on these suggestions. We all know very well that the kind of carbon that will do for one purpose will not answer for another, and the carbon that can be used economically in the summer, certainly cannot be used in the winter.

Concerning the matter of globes, in places where you do not require a very bright light you can use an opal globe to obscure it. Where you want all the light you can get you can use a clear globe, and in other cases you can use a half-ground globe. I expected Mr. Gregory, of the Union Glass Company, here to take up the question with regard to the proper materials for making globes. As he is not here, I hope Mr. Libbey will give us some information on that subject.

Mr. Morrison: [Mr. E. R. Weeks, Vice-president in the chair]. The question of carbons is a very important one to the electric companies, and by great competition the price has been reduced from $66.50 a thousand down to $10, the lowest figure quoted in the market. This was owing simply to the sharp competition engendered by the enormous profits made by the Brush Company when they first put the carbons on the market. The first break was made by Mr. Boulton, originally an employee of the Brush Company, who, after having served with them for a certain time, and observed the enormous profits that were made in that line of business, fairly presented the subject to the enterprising capitalists of Cleveland, and induced them to establish a rival carbon factory. The establishment of this factory has made Mr. Boulton a benefactor of the electric light companies. Following this break came a number of

other small manufacturers, so that we are to-day supplied with a $10 instead of a $66.50 carbon. The information that Mr. Ridlon has gathered together would lead one to believe that the difference in the quality of the carbons is as great as the difference in the manufacturers. Is that right?

Mr. Ridlon: Yes, sir.

Mr. Morrison: That is not so. Our company has used the carbons manufactured by the Boulton Company, by the Pittsburg Carbon Company, by the Parker-Russell Manufacturing and Mining Company, by the Brush, of course, and, I think, by one or two others. Nearly all of them have given fair satisfaction in our service. The proof of the pudding is in the eating, and the proof of this statement lies under your observation every night you walk the streets of Baltimore. There are the lights, with the carbons we are using. We do not mix carbons of different manufacturers upon the same circuit, because that would not be giving fair play. The defects in a lamp might possibly be attributed to the carbon itself, when the carbon would be all right. I wish to give you all the information we possess. This Association is organized for the purpose of disseminating information among the subordinate companies. There is one thing that will transpire within the next twelve months which will compel fair play, not only in carbons and globes, but in the matter of machinery and other supplies used by the subordinate companies from the parent companies, from whom the apparatus and supplies have been obtained. [Applause].

You will observe that that applause comes from points where there are no electric light companies represented. Some of them are supply-men who applaud. I reckon they have had their shoes pinch them.

I do not know that I can add anything further to the question of carbons. As to the matter of globes, we have found a difficulty in obtaining a sufficient degree of promptness in supplying our orders, and for this reason we have bought globes from almost every

manufacturer within our reach in the United States. Our principal purchases have been made from the New England Lamp Company, and I am glad to say we have received a fair quality of goods and fair treatment from that company. When troubles arose with their goods they hastened to rectify them. When a change in the form of a globe was needed, they willingly changed it; so that of the globe-men we have not such serious complaints to make as we have of the carbon-men.

MR. WEEKS: Except that they break so frequently. I am a little inclined to think that they manufacture them to break. I would like to know whether they are all of flint glass, or just how they are manufactured.

MR. MORRISON: I will leave the manufacturer to tell his own story. We have been fairly fortunate in the globe business. Now, we have the chance to buy firsts and seconds. The seconds are sometimes better than the firsts; and then there is another case of a pine partition an inch thick between the two.

MR. RIDLON: I have listened to Mr. Morrison's statement, but still it does not cover the ground on which I based my report on carbons, which is simply this: I recommend that the electric lighting companies should adopt a test, or discuss here what would constitute a fair test for the carbon which should be known as a standard carbon, in order to arrive at some point where we will make our proposition to the carbon manufacturer of what we require. The other part of my argument, in regard to taking seconds, was simply a question of compelling them to live up to their agreement. I do not know what your experience is, but I can answer for the experience of the Brush Electric Lighting Company of Boston, that the poor quality of carbons is one of the most expensive things about the business. The deduction on monthly bills for electric lighting owing to defects in the carbon may occur four or five times in a month at seventy-five cents for each day. Now, add that to the price of the cheap carbon, and it will bring back the cost of carbon to the old price of

sixty-five dollars almost before you know it. Then, added to that is the annoyance of complaints from the customers and the general discredit of electric lighting. Now, I am not here to make a price for carbons, but we certainly should get a good carbon in some way or other, if we can. What we want to accomplish by a discussion among practical electric light men is, if we can, to arrive at what is best for us to have, and then ask the manufacturer of carbon to produce such an article. We will hold this restriction against him, that if he ships us fifty thousand carbons, and we find that ten thousand are firsts and the balance do not come up to that standard, we can compel him, by not paying him but half-price for those, to be more careful in his selections.

MR. COOPER: To expedite the matter, I move that a committee of three be appointed to investigate the carbon question, looking to the adoption of a standard.

MR. KING: In answer to Mr. Ridlon, I will state that our company wants first-class carbons at about half the price we are paying for seconds. As a matter of fact, we are using Brush second carbons. We have been using them for months. We use nothing else, and the only difference which I have been able to observe between the firsts and seconds is the stencil-plate mark on the box. So far as practical results are concerned, I do not see but that we get just the same in the seconds as we do in the firsts.

THE CHAIRMAN: The gentleman will please address his remarks to the question before the house.

MR. KING: I would, if I knew what the question is.

MR. FISHBACK: The way in which Mr. Ridlon puts the question seems to me to give to the electric light superintendents a good deal of leeway, and there may be some superintendent not so conscientious on the quality of carbons as Mr. Ridlon would probably be. I believe that carbon manufacturers in general are disposed to do the fair thing. An electric light company may get fifty or a hundred thousand carbons, and find they are not up to the standard, and then refuse to pay the price. The carbon manufacturer might be

disposed to do the right thing, but the superintendents of lighting plants might not be conscientious.

Mr. Cooper's motion was carried.

THE CHAIRMAN: I will appoint on that committee Mr. Cooper, Mr. Ridlon, and Mr. Fishback.

MR. BARTLEY: I do not think that it is right that any carbon manufacturer should have a voice in determining the standard.

THE CHAIRMAN: The point is well taken. I substitute Mr. King for Mr. Fishback.

MR. RALPH W. POPE: I asked whether the globes were or were not manufactured with an idea of breaking. While the profit may not come from running the lamps, it may be very lucrative to the manufacturer who made the lamps and sold them. As I understand it, there is quite a difference in the quality of glass as regards changes in temperature. In old times kerosene lamps lasted a long time. Now a chimney will not last while the light is being turned up. I think very likely that Dr. Moses, in the course of his investigations on incandescent lamps, has learned some points in regard to this which he can give us.

MR. COOPER: As it is getting late in the day, I move that we adjourn until 4 P.M.

MR. KING: Let me say, if you please, that the pulley, of which we heard something on the first day, is in the electric light company's room at the head of the stairs, and we would like to have all the gentlemen see it.

The motion to adjourn was then put and carried.

AFTERNOON SESSION.

The Convention was called to order at 4.15 P.M.

The Secretary read a letter from William S. Swift, recommending Detroit as a place for holding the next meeting; also a letter from W. C. Turnbull, inviting the members to inspect a telephone transmitter.

The Secretary read the following resolution, which was unanimously adopted:

Resolved, That this Association sincerely mourns the death of Mr. A. J. Holt, of Cleveland, Ohio, a highly esteemed and capable member, whose intelligent work, had he lived, would have been of great value and interest to this Association.

Mr. De Camp handed the following preamble and resolution to the Secretary, who read the same to the Convention:

WHEREAS, The last two meetings of the National Electric Light Association have been held in the East, and as the time of the next meeting is in the month of August,

Resolved, That the Executive Committee be requested to call the next meeting in Detroit.

(Signed), WILLIAM H. FITZGERALD.

The resolution was seconded by Mr. Ridlon, and adopted.

The Secretary also read the following resolution, which was handed to him by Mr. De Camp:

Resolved, That the Chair appoint a special committee—to be composed, as far as practicable, of the representatives of each system—to consider the relations of the sub-companies to their respective parent companies, and to act in conjunction with any existing committee which may aid them in harmonizing any differences that may arise, in order to bring about a more hearty co-opëration, so much to be desired and so essential to the welfare of all concerned.

The resolution was seconded by Mr. King, and adopted.

MR. KING: Your committee on nominations beg leave to submit a report. I wish merely to state that in naming the executive committee we endeavored to ——

THE PRESIDENT: The gentleman will please hold that report for the present. Any other business, Mr. Secretary?

THE SECRETARY: No, sir.

THE PRESIDENT: Mr. Woodbury will read a paper on "The Relation of Electric Lighting to Insurance."

Mr. Woodbury: The competition, forcing the struggle for existence in modern civilization, is not shown anywhere in a more marked degree than in the demand for time. Like the dying royal reprobate, it cries: "Millions for a moment of time!" and seizes upon every expedient which will add to the measure of time at its disposal. Rapid transportation in shortening unavailable time, and artificial illumination in lengthening available time, minister to the necessities of commercial and home life, and form our greatest industries. Transportation requires more capital than any other industry, about twenty per cent. of the live capital of this country being invested in railroads. The several methods of artificial illumination, and their kindred industries, are second on the list, requiring somewhat over two per cent. of the invested capital.

Both of these subjects have received the careful attention of legislators, and these interests have reached such magnitude that the most carefully-phrased legislation has been enacted to defend the individual against the undue exercise of corporate power.

The numerous and continuous injuries to person and to property, in spite of all precautions, have caused the most stringent statute laws relative to the production of artificial light. Although differing in the several States, all relate to similar measures, such as: Oils for illumination must exceed certain fire-tests, must be stored in covered buildings, cannot be left near the highway; and numerous regulations control matters relative to transportation and sale, and also to their use on railway, coast and internal marine lines carrying passengers at night.

The varied legislation in respect to burning gas fixes minimum limits as to luminosity, percentage of poisonous gases, the rights and responsibilities of gas companies in the franchises permitting them to enter upon and open highways; and one State, at least, possesses a law which can be construed as forbidding a gas meter operating as perpetual motion.

This class of laws has been a necessity in the endeavor to reduce the casualties resulting from the use of artificial light; and wide as they are in scope, and exact in details of enforcement, the painful consequences following the use of oil and gas show that these laws fall short of their purpose.

At this time, we have occasion to consider only one of the several methods of illumination; and it is remarkable that electric lighting, which is in general use throughout the country, and containing, like all other forms of energy, well-known possibilities of danger, has never been the subject of any State law yet in force. City ordinances have been passed for a purpose, and to no purpose. The questions of the safety of electric illumination have, thus far, been settled by the electric interests

without intervention of the law; and I venture to state that the instance of an industry voluntarily assuming its self-government for the direct weal of other interests is without parallel. When electricity was first applied for illumination on a commercial scale, it was a business without precedents; everything was new, crude and undeveloped. The leading inventors were absorbed in the solution of their problems; no trained assistants were available; the books contained nothing on the modern application of dynamo currents; the scientific schools could teach but little, except general principles; telegraphy had but little in common with the subject beyond its terminology; so that neither technical graduates nor telegraphers were prepared to enter upon the work without further training. Mechanics had much to learn in matters of construction of apparatus; the proper manufacturing supplies were not in the market; and the best steam engines for meeting the conditions for the best operation of dynamos have appeared since that time. The development of the whole business required invention, education and organization from one end to the other.

Considering the nature of the difficulties which were surmounted, the wonder is, not at the mistakes, but at the success.

One of the elements naturally disregarded at the outset in the rush to invent, make and install the apparatus, was the possibility that electricity might, like other methods of lighting, become a cause of fire.

Soon numerous fires served as a reminder that electricity, as applied at that time, possessed no immunity from consequences similar to those resulting from other methods of illumination; and public opinion, for a time, had a tendency to veer to an extreme position—even farther from the truth than its first assumption, that electricity could not produce a fire.

A careful examination of the circumstances attending a number of these fires, and a repetition of these conditions upon electric lighting plants, served as the basis of the regulations for the use of electric lighting apparatus, prepared by the writer for the factory mutual insurance companies a little more than four years ago. It would have been impossible for the work to have been carried on had I not received the most cordial co-operation from the electric light companies, and the electricians at the head of these companies freely gave of their experience in the endeavor to determine the facts at issue.

The results of this work warranted the opinion that a well-arranged electric lighting plant was the safest method of illumination, and the experience of time has sustained that position.

The essentials for safety in an electric lighting plant are few and simple. In the presence of combustible material arc lights should be enclosed in globes resting on closed stands, with a

raised edge, confining the sparks and copper; and some extra stop at the bottom of the lamp to prevent the lower carbon from falling in any contingency. The feeding apparatus at the lamp should prevent the formation of an undue arc in case of any disarrangement. Switches should be constructed so that an arc could not be formed by their use. The electricity must be confined to its metallic circuits, and the conditions of its use controlled.

The regulations found necessary to specify these particulars in detail are of some length, but do not embody any other features. Experience has shown that they have served the purpose for which they were intended, for I do not know of any fire from electric lighting apparatus, except where they have been violated.

The chief elements of danger are conductors of high resistance, generally formed by two earth contacts, and sometimes by a conductor between two wires of different potential. Such diversions of current are generally caused by water penetrating the insulation; and it is of importance that the insulation be waterproof wherever there is liability of exposure to moisture.

The enforcement of these rules by the factory mutual insurance companies, and the Boston Fire Underwriters' Union, was based upon an inspection which was recorded upon the accompanying blank, by underlining the items to be specified; spaces are left for negatives, and the addition of notes of a more general nature. Further remarks can be written on the other side of the sheet, where it is dated and signed by the inspector. Attention is called to items requiring correction by an "X" in the margin.

REMARKS.

Date 188

Signed: ....

For inspection use, these blanks are secured by rubber bands in a small portfolio the size of a pocket note-book, and after a record has been made upon them, they are filed away at the office.

Careful attention should be given to the importance of daily tests for ground connections; and for this purpose an ordinary bell magneto is the most convenient apparatus. The electric bells, and small galvanometers, with low resistance coils, frequently used for this purpose, are not sufficiently delicate, as they cannot indicate a weakness in the insulation, unless its resistance be less than ten to one hundred ohms, according to circumstances.

The general average of electric plants has no place for the expensive apparatus and methods necessary to measure the resistance of the insulation of the system. Whatever method may be employed for permanent testing, the line connecting the electric light circuit with the testing apparatus, and thence to the earth, should have a spring switch, which could not be left closed and thereby ground the circuit.

I have used, for several years, the portable magneto which I devised for the purpose of inspection testing. The shaft of the driving pulley is at right angles to the armature, and this allows it to be placed in a small flat rubber case, which contains two flexible steel reels, each thirty feet in length, which serve as conductors between the circuit and the earth.

The value of this method of inspection which I have described is shown by the results following its adoption. In the autumn of 1881, and winter of 1882, twenty-three fires were caused by sixty-one electric lighting plants in mills insured by the factory mutual insurance companies in the eastern portion of the United States. The apparatus was inspected, and the alterations necessary for safety specified and carried into effect; and there has not been a single fire from electric lighting apparatus on this property since that time, although the number of mills using electric lights has increased to nearly 200, and the average size of the plants greatly enlarged. From being a legitimate cause of apprehension on the part of the underwriters, the hazard of electric lighting in this field, at least, has subsided into a matter of routine inspection.

There is a prospect of new matter at issue, which will tend to reverse the present conditions relative to safety in connection with the distribution of electric lighting. There is a widespread feeling of opposition to ærial electric wires; and several city governments, with the intrepidity of practical politicians, have passed ordinances decreeing that the wires must be buried.

In the present state of the art of supplying arc lights from central-stations to scattered clients, the execution of such

measures, if rashly entered upon, would be simply prohibitory, depriving the public of the enjoyment and protection derived from thoroughly-lighted streets, and limiting its use to those who have boiler, engines and complete electric lighting plant on their premises.

It is well known that the use of all underground electrical conductors is attended with special difficulties. The first trans-atlantic cable resulted in a failure through the efforts to operate it in a manner similar to a land telegraph line; the telephone companies have concentrated their best forces upon the problem with indifferent success; the telegraph companies have not been idle in looking out for their interests in the matter, and one of them has been engaged in experiments upon underground wires for several years without obtaining satisfactory results. The telegraph system, as Professor Morse invented it, did not contemplate other than underground wires, and ærial wires were put up as a matter of necessity where it was impossible to bury them on the stone viaduct of the Baltimore and Ohio Railroad at Relay Station, and the nine miles of wire buried along the right of way of the railroad, between Relay Station and Baltimore, was abandoned because the insulation could not be maintained, and an ærial line substituted along the whole distance. On this occasion it is necessary to confine the consideration of underground wires to conductors of electric lighting currents as being the only phase of the question germane to the objects of this Convention.

Mr. Edison, with his inventive skill, supplemented by the immense financial resources of his company, has designed and laid a system of underground conductors for incandescent lighting from central-stations, distributing lights over a small area in the denser portions of cities containing his stations. It serves its purpose, which is to conduct electricity at a tension of one-thirtieth of that used on some arc lighting circuits. An insulation of sufficient resistance to be adequate for incandescent circuits would not be suited for arc lighting conductors. Mr. Edison invented that system of underground conductors for the specific purpose of adapting it to his system of electric lighting, and as relatively simpler as such a matter may be than the invention of a feasible method of burying arc-lighting wires under the present limitations of consumption. It may be noted that no other incandescent electric lighting interest has made any installation of any method of underground conductors. Portions of his central-station circuits are above ground, as is the whole of his "village system" of lighting; and his "municipal system" is not only above ground, but uses electricity at an electro-motive force of 1,000 volts.

The distinctions between the conditions involved in the general problem of underground wires and those of an incandescent

system feeding a limited territory, have been stated, in order that this specific case may not be cited as a reason why all electric wires could be treated in a similar manner.

Like all parts of an electric light system, the conductors, whether ærial or subterranean, must be insulated from connection with the earth. For underground wires this substance must possess a wide range of physical properties in addition to high electrical resistance; it must be uninjured by extremes of moisture or dryness, or variations of natural temperature; it must not be acted upon by sewerage or coal gas; not rendered defective by strains due to the settling of buildings or the impact of traffic; furthermore, it must be cheap.

In all other forms of electric apparatus, a fault or leakage is merely an interference to the operation of the system, but in electric lighting a fault includes all this and the liability of as much injury to person or property as may be possible by the amount of energy diverted from the circuits.

The clothes-line system of overhead wires adds no beauty to the landscape, but that is no valid reason for its abolition, except to those adherents of Ruskin who may endorse his fierce diatribe against the railway system as destroying the beauties of natural scenery by its cuttings and fills, its nerve-thrashing noise and black belched smoke, and above all, the utter absence of lines of beauty in either road-bed or rolling stock.

The few instances where wires over buildings interfered with ladders of the fire department might have been avoidable by the further elevation of the wires, or by their crossing the streets at nearly right angles. In the natural course of improvement, the lines in cities are being changed from their scattered courses and systematized upon permanent fixtures high enough to carry the wires a reasonable distance above all roofs. Ærial wires certainly furnish the most ready means for electric companies to reach their customers, who are frequently distributed very unevenly over a city, and, like all other seekers after trade, may at times conflict with other interests.

The network of wires over cities serves as the most efficient protection against lightning, these conductors, by their great number, scattering the force of thunderbolts and conducting them to earth. On this account thunder-storms are much more destructive in the country than in cities.

As to personal danger, a line-man is in infinitely greater danger from gravity than from electricity.

I repeat that most of the fires from arc lighting systems have resulted in the diversion of the current by two contacts, one of them being a ground, which had existed for an unknown time, and the second being an accidental ground, generally of increasing resistance until it converted the electricity into heat, whose

temperature was high enough to ignite combustible material. When a ground exists anywhere on a circuit, this ground is trying to form a second connection at the weakest point in the insulation anywhere on the whole circuit, irrespective of position. The one connection to earth may exist near the dynamo, and the other in some building at the extreme portion of the circuit, or it may be only a few inches away.

When the conductors are secured to elevated supports they can readily be kept free from all such earth connections, and a casual inspection shows the places liable to defects, and the necessary changes can be made. With an underground system, this danger exists everywhere along the line, and is difficult of location and remedy, while the natural deterioration of material renders the hazard an increasing one.

The agitation of the subject has stimulated inventors, and the protection of the Patent Office has been invoked accordingly upon divers methods of covering and grouping wires to be laid in a trench, most of them devised on the Mede and Persian principle, inasmuch as when once laid away further changes would be unfeasible.

Many underground arc-lighting circuits have received faithful trials without obtaining satisfactory results which would warrant their adoption by any form of American practice. In this connection, I wish to cite several instances where such trials have been made. A large contract for lighting a park was offered to an electric lighting company upon the condition that the wires be placed underground. An electric light company in Boston made preliminary experiments by laying 1,200 feet of one of their circuits underground. The conductors consisted of No. 4 copper wire, covered with rubber insulating composition one-eighth of an inch thick, and further protected by two thicknesses of cotton braid. The two wires of the loop were laid in grooves a foot apart in a plank laid three feet below the pavement, and covered by another plank. The resistance of the insulation of this circuit exceeded 90,000,000 ohms when first laid, but it diminished until the repairs made necessary by the frequent escapes became so burdensome that this underground line was abandoned and a different line laid in a wooden conduit, with cleats arranged so that the wires could not approach nearer than a foot to each other. This second line consisted of the same size wire covered by a rubber insulating compound and inclosed in a lead tube; and this wire, like the former one, proved a failure in the course of a few months.

The faults were caused by a disintegration of the insulation entirely different from anything similar resulting from the use of the same kind of insulation above ground.

At these places the wire would become vaporized and attenuate, similar to a pair of arc light carbons, the connecting filament becoming smaller, until an open circuit was established.

In Philadelphia, the escapes from an underground system of electric arc light wires, on Chestnut street, are believed to have been the cause of several severe explosions of illuminating gas leaking through the ground. On Delaware avenue, in the same city, an underground circuit with different insulation, received a careful trial, until the escapes, through defective insulation, in spite of numerous repairs, diverted so much of the electricity from the circuit that the lights could not be maintained, and ærial wires were substituted. The temperature of these escapes was so great that the sand was partially fused in places; and if the lights had been inside of buildings, there would have been a liability of such points of excessive heat occurring in the presence of combustible material with destructive consequences.

The result of a few weeks' experience with a short underground circuit is no measure of its capacity to fulfill the requirements necessary for central-station arc lighting, as it requires time to develop the faults in such conductors.

Aside from the question of overwhelming cost, there is no opportunity in cities to lay down sub-ways without such serious interferences with gas, water, and steam pipes, and sewers, that it would make their construction unfeasible. An underground circuit must be either a buried conductor, or wires run through a conduit of small dimensions. The insulation of buried conductors, from those of Prof. Morse, in 1843, to the present day, has not been sufficiently permanent to reach satisfactory results, although such cables have given excellent results on submarine work, where they are free from many of the severe conditions imposed on them by underground service in cities.

It is clearly essential that the insulation upon wires in conduits must be supplemented by the material of the conduit also serving as an insulator.

In the oft-quoted sub-ways of Paris the wires are not in contact with the walls, but are attached to insulators fastened to beams placed transversely across the sub-way, or against the wall, and are, therefore, suspended lines surrounded by an insulation of air. The use of underground systems would add to the obstructions of opened streets, increasing the measure of annoyance and danger arising from excavations in the highway— a difficulty which will increase in time, whether lines were successful or not; for if successful, the increased patronage would require additional wires, and if unsuccessful, the constant repairs and alterations in the hope of obtaining satisfactory methods would require certainly more occupation and interference with the highway.

Admitting each statement alleged against overhead wires, there would still remain the fact that the experiment of underground wires involves dangers and difficulties that should not

be rashly entered upon, lest, like the discontented frogs in the fable, king stork takes the throne of king log.

In conclusion, it may be said:

1. That the present application of electricity forms a relatively safe method of lighting.

2. Underground wires conducting lighting currents contain elements of serious danger in proportion to their defects of insulation.

3. The compulsory burial of all electric wires would be oppressive to the electric interests.

Our methods of life are so closely interwoven with the uses of electricity that we are dependent upon its applications, especially to transmission of speech, telegraphy and illumination; and any interference with the legitimate exercise of those interests will not be measured by the impaired value of plant or load of excessive expenditures, but will be a detriment to each member of the community now benefited by its use. [Applause].

THE PRESIDENT: Gentlemen, the paper is before you for discussion. Because of the subject, the insurance men of Baltimore were invited to be present at this session to listen to the paper which has just been read. If there is anything in it that they desire to criticise, we would be glad to hear from them.

MR. W. S. WILKINSON: I desire to say that I think all of us appreciate very highly Mr. Woodbury's paper; and, so far as the insurance part of it is concerned, must necessarily endorse it, because of his experience, which is, perhaps, the best of any man of his age in the country. We also tender our thanks to the President of the Association for inviting us to be here, and to Mr. Woodbury for presenting this very interesting paper.

GENERAL JAMES M. ANDERSON: I have listened with a great deal of pleasure to the paper, and speaking for the underwriters of Baltimore, I have to say that we are entirely in your hands, so far as electric lighting is concerned. We are not favored, as other underwriters are in larger cities than ours, with a careful supervision and a constant inspection of the wires. You are aware, sir, that we in Baltimore have had comparatively few fires from the electric light. I cannot remember more than two or three. We are perfectly satisfied that if the wires are carefully and properly introduced, and

looked after almost every day—speaking from my standpoint, without any knowledge whatever of the force of the electric current—that they are quite as safe, if not more so, than a gas light. The persons employed on our bay steamers assure me that the electric light gives a great deal more satisfaction than the gas light. I have only to say, sir, that by carefully introducing it into warehouses and dwellings, I am satisfied, for my own part, that the electric light will be of very great advantage to us. I speak with diffidence about this matter, for I had occasion two or three years ago to speak to a gentleman in regard to the electric light, and I remarked to him that this system of electric lighting is yet in its infancy. He said: "My dear sir, it has not been born." I and my colleagues here, of the insurance fraternity, are very grateful for the paper which the gentleman from Massachusetts has read before this Convention to-day. [Applause].

Mr. Ridlon: I would like to say a few words in addition to what Mr. Woodbury has already said, which will, perhaps, be somewhat of a benefit to insurance men. We have in Boston a New England Insurance Exchange, which appoints inspectors of local plants throughout the towns or cities of New England that are not in the Manufacturers' Mutual Insurance Company. They are all very nice gentlemen, and are very anxious to do just what is right in regard to this matter; but they lack organization and a great deal of information. Now, I suggested that for the purpose of adding to their information they invite the electric light people to meet with them as frequently as circumstances may require, to go into all the details of any new improvements for the protection of buildings from fires that may occur from electric light plants. The owner of the electric light plant has much more at stake than they have. We cannot afford to have any fires. It would be very detrimental to our business. They accepted this proposition, and are thereby gaining a better knowledge than they had. Then also the wire-men who are employed by the different elec-

tric light companies should have a system of instruction the same as is required in the case of an engineer before he gets a certificate qualifying him to run an engine. I think you will find this a very great improvement here. You may not see the necessity of it to-day, but I think you will in the future, and I would like to have this additional inspection added to Mr. Woodbury's report. This matter, of course, refers to property over which the Mutual Company has no control. It comes under general insurance.

MR. GILBERT: One matter, I think, has escaped the attention of this Convention in respect to reducing the cost of producing the electric light, and that is the matter of insurance. We have been rated by insurance companies as extra hazardous, when every man in the business knows that an electric light station is constantly under the watch of some of the employees, and that it is exactly the reverse; so that in the name of the New Haven Company, we sent a circular letter to about one hundred of the local companies, and if you will permit me, I will read it. It is as follows:

The position taken by the board of underwriters of the insurance companies in advancing the rates of insurance upon electric light plants, on the ground of their being an extra hazardous risk, has induced us to investigate the question of mutual insurance. The experience of the mutual insurance companies insuring factory property of all kinds for the past fifty years has clearly shown that mutual companies can furnish insurance for less than one quarter the cost of the business as done by the stock companies. We believe that a mutual insurance company can be formed by all the local electric lighting companies of the country, in such a way as to insure the plants for less than one-quarter what it now costs the companies for insurance.

We have conferred with the managers of the largest mutual insurance companies of New England, and they concur with us in all we have said. To enable us to lay this matter before the Convention in Baltimore, in February, in an intelligent manner, so that the necessary action may be taken to organize the Electric Light Mutual Insurance Company in proper form, we desire immediate answers to the following questions:

1st. Would you be in favor of such an organization?

2d. Is the building your plant is in built of wood or brick?

3d. Is it more than one story in height, and if so, how is it occupied?

4th. What is the entire amount of insurance you are now carrying on your plant?

5th. Please state amount per year paid for such insurance?

6th. What the loss would be if totally destroyed by fire?

7th. State your losses by fire in each year since the plant was started?

We feel deeply interested in this question, believing it will be largely beneficial to all local electric lighting companies, and hope that you will answer promptly and fully the above questions, addressing us at New Haven. Respectfully,

F. A. GILBERT, *President;*
J. ENGLISH, *Treasurer,*
New Haven Electric Co.
Bridgeport Electric Co.
Newport Illuminating Co.

NEW HAVEN, CONN., Jan. 25, 1886.

We sent out more than one hundred of these circular letters, and received replies from thirty-one companies. The total estimated amount of loss in case of total destruction, was $1,178,000; amount of insurance carried, $481,000; premiums paid varying from three-fourths of one per cent. to four per cent.; total premium paid on the amount insured at these rates for three years (the time that several of the plants had been in existence) amounted to $19,112.25; the total loss in three years by fires amounted to $1,000, or $6\frac{7}{10}$ of a mill on the amount insured. Were we to organize a mutual insurance company, with a governing board to consist of members of the electric light companies, we should not only be able to reduce the cost of insurance, but would be in a position to reduce the amount of loss. If we have a mutual insurance company, governed by members of the electric light companies as directors, I think we can oblige the parent companies to repair our dynamos, etc., at the actual cost of the labor and material, they having once had their profit for their patents, and not being entitled to a second profit. There are only thirty-one companies who replied to these reports. We believe that there would be in the United States an insurance of at least five millions on the present companies now existing, and in five years it will, no doubt, be trebled. We know that some of the

mill companies will take our insurance for less than we are paying now, but I do not think we should be so well fixed as by having a mutual company formed of the electric light companies. I know a case in one of the stations I am connected with where there was a slight damage to one of the dynamos. The parent company was called upon to examine it and report the expense of repairs. They sent in an estimate at a cost of $234.30. That, of course, appeared outrageous, and so the superintendent of the station took one of his best men, who said he believed he could repair it. He procured him all the necessary materials and tools, and when he put the dynamo in, it run in as good order as if it had been repaired at the factory. The actual cost was $24.30, and this bill with the estimate sent in we have pinned together and intend to frame. I really do not blame the stock companies for regarding our plant as an extra hazardous risk, since the parent companies treat us in this manner.

MR. CLEVELAND: Residing in an insurance city, it has been very convenient for me to get information upon this subject which has been so clearly explained by Mr. Gilbert, and I am quite sure that his statements are correct. I am also sure that this Association will approve his plan. It is fair to say, however, that Mr. Gilbert and his friends will not depend upon any action of this Convention in regard to carrying out his plan of organizing his company. What he desires is that we approve and take an interest in it, as I have no doubt we will. I therefore beg leave to read a resolution:

Resolved, That the Association endorse the plan of organization of a Mutual Electric Light Insurance Company, and that the Chair appoint a committee of three to perfect such organization.

The motion was seconded.

THE PRESIDENT: I am not sufficiently familiar with the insurance business to pass any opinion upon it; but upon general principles I am opposed to going into any matters outside of that for which our Association was

planned. I am equally opposed to lending the name and sanction of this Association to any scheme outside of its legitimate business. Therefore, when this question is called I shall, for these reasons, vote against the adoption of the resolution.

MR. CLEVELAND: I do not think that is a fair way to put it. Here are members of this Association from all parts of the country interested in the economy of running their plant. Now, it is very clear to me that if these gentlemen organize themselves into a self-protecting insurance company, this Association is lending no influence to it. The individual members have a right to do that, Mr. President, I take it. Now, suppose Mr. Gilbert and his friends organize this company. Here is a man who wants to insure his plant. This organization will insure it for one-half of what a stock company would charge him. Now, is there a man running an electric light plant in the country who would not get his insurance there? He would get his insurance in the cheapest place he could obtain it. It seems to me that the members of the Association have a right to lend themselves (using your phrase) to an arrangement of this kind, so that they can save money in their insurance. I look upon it as a fair, honorable and economical business enterprise for the electric light companies, and I hope this Association will pass that resolution.

MR. RALPH W. POPE: As there are gentlemen here who are properly informed, I would like to inquire as to the comparative rates of insurance—*i. e.*, what other classes of risks beside the electric light plants are esteemed extra hazardous? Whether it is not the fact that the electric lighting companies are overcharged for their insurance for lack of the very information that underwriters should have from this Convention, or from such a series of inquiries as have been put by Mr. Gilbert? It seems to me very important that electric lighting stations should not be rated as extra hazardous, when, according to the statistics just read, they appear to be extra safe. On that point I would be glad to have a little light.

MR. MORRISON: [Mr. Weeks, Vice-president, in the chair.] I do not want my language so construed as to mean that any member of this Association, in his personal capacity, has not the right to go into any business that may suit his taste and judgment. I only want to say that the National Electric Light Association was formed for a specific object, and that object does not include the insurance business. The necessary steps to form an insurance company must be taken outside of the Electric Light Asssociation, so that all you can do in your capacity as an Association is to lend your sanction to the organization of an insurance company. Whatever the rates of insurance may be in Connecticut, and within the jurisdiction of Mr. Gilbert's companies, the rates of insurance under which our companies are insured are fairly reasonable, and we have no cause for complaint. It seems to me that the paper which Mr. Woodbury has read to-day will go further toward lowering the rate of insurance than anything you can do in the way of holding the promise (I won't say the threat) of an organization over the heads of men who are already engaged in their legitimate business. I do not understand anything about insurance, but I do understand something about the National Electric Light Association, and the ground I am taking is that you are going beyond the object for which the National Electric Light Association was inaugurated. I do not mean to say that you could or could not get the insurance. The Baltimore station is insured to the satisfaction of the board of directors. That is all I have to say in that connection. We have no fault to find. But I am now talking against the propriety of this Association lending its name to the endorsement of a scheme for the establishment of an insurance company. It makes no difference whether it be a mutual insurance company or any other company. That is the ground I desire to take.

MR. LINNELL: I will give one illustration why I, as the representative of a manufacturing company, and therefore being directly interested in a large number of sub-companies, will support Mr. Gilbert's suggestions with all the sincerity that I can lend to them.

I have just come from Richmond, Va., and during the fourteen days that I was there six fire insurance companies of the United States cancelled successively six insurance policies, and the reason that they gave therefor was this—not that the building, the apparatus in the building and the connections used there were unsatisfactory, but that it was the first electric light station in the city of Richmond, and they had not had sufficient time to investigate the matter to give us the insurance. I will mention one company in Hartford which refused to insure the station on that ground—that is the Hartford Fire Insurance Company. At the same time they said, "We will not insure your station for less than one and a-half per cent.," and the consequence is that the offer which we made to have the station insured at one per cent. was rejected in fourteen days by six successive companies, and to-day we are insuring it at one and a-half per cent. We have other illustrations of the same nature, where we are meeting with the same difficulties with insurance companies all over the country, and we feel that we would like to enter into the organization of a mutual company and do all we possibly can to assist in the organization.

Mr. Woodbury: As the theme of my discourse was on an entirely different phase of subjects relating to electricity, and as the insurance interests that employ me do not propose to enter into this insurance, I can speak upon the subject very freely. A few weeks ago Mr. Gilbert, with some of his friends, called at our office with inquiries to know if their electric light station could be insured in the Factory Mutual Insurance Company. Our first reply was that that matter would be very undesirable irrespective of any question as to the risk attached to an electric light station, for the risk of an electric light station isolated is very small. Our experience for thirty-five years, to the amount of $59,338,000, has been a loss of eleven cents and seven mills per hundred dollars of insurance per annum—less than one-eighth of one per cent. Now some reference is made to this mutual insurance company. All insurance is a tax. It is the heaviest tax

in this country. It is the distribution of the losses of the few to the many. The cheaper the administration of that tax can be carried out, the better it is for all interests. The amount can be fixed most equitably by class insurance. About fifty years ago Zachariah Allen, of Providence, built a mill in which he introduced many improvements of equipment and construction. It was the first property with a pump for fire purposes only, and it had besides many other original features. After the mill was finished, he submitted his plans to the president of the insurance company in Providence, and was listened to with satisfaction. At the end of his interview he said: "Now, Mr. President, you have appreciated my effort to reduce the hazard of fire in this mill. I wish you to come up to my mill and examine it for yourself, and, from your experience in such matters, make up your mind as to the probable hazard and charge me a diminished rate accordingly." The president of the insurance company replied: "Mr. Allen, a cotton mill is a cotton mill; the rate is two and a-half per cent., and we have no time to go into the country to examine your Yankee notions." As a matter of fact, a contract was made between manufacturers there, by which they agreed to make special alterations and share each others losses. An insurance company was formed on that basis. These factory mutual insurance companies have confined themselves to thoroughly protected, isolated manufacturing property of good construction, and by keeping themselves in that class they have been remarkably fortunate. They now carry a little over four per cent. in a month of all the insurance in the United States. Last year they wrote four hundred and five and a-half million dollars. Their losses by fire were $13\frac{1}{15}$ cents on a hundred dollars. The cost of taxes and net cost of administration were about two cents more, making the cost of insurance fifteen cents in a hundred dollars. Supposing you think fit to insure your electric light station and can get the owners of enough stations, not those who are merely tenants in buildings, but where you are entirely separated, as in this Brush

station in Baltimore, you could certainly form a very successful company, sharing your losses; and, by conducting it with economy, it would be the cheapest method, undoubtedly, of protection against fire. But there is no magical result of diminished cost in the matter of mutual insurance. The plant has to pay the average cost of the chance of destruction by fire. You make a selection of those risks, keep them together, and your chance of fire will be small.

In regard to what the last speaker but one said (not being a member of the Association, I cannot advise,) it seems to me that the voice of this meeting would be merely advisory, perhaps commendatory, of such a measure; but whatever is done must be done by the individual action of some of you. The Mutual Insurance Company does insure one very excellent electric lighting station. I do not think that they carried it beyond that. There are very few such nice stations as the one in Baltimore. It is a class of very small hazard, and something that you ought to control yourselves. I believe you have the self-discipline in the business of electric illumination to accomplish these results. Of course, there is more or less machinery to it. One great feature, besides the selection of risks, is the continual inspection by trained inspectors. The rubber interests who wish to be insured formed their own company, carrying many million dollars. There are some at this Convention who are insured in that company, if I remember rightly. It seems to me that the limits of this meeting must be advisory, as a matter of one individual with another. But I will say, however, that the New England Cotton Manufacturers' Association very frequently considered questions of this factory mutual insurance, not binding the members however. A number of members of the Association are connected with property insured in the Factory Insurance Company, and insurance is one of the constant taxes upon property, and, therefore, a factor in the prosperity and in the cost of production; and anything that helps that matter, of course adds to the prosperity of the business in which you are engaged.

Mr. Renshaw: I would state that within the last year we have suffered from fire in Washington. We had our station destroyed during the last summer, and owing to the general prejudice that insurance companies seemed to have in that locality, we carried very little insurance, and our loss was very heavy. We have now a very fine isolated station, and the risk of fire is very slight; but if that could be insured at a reasonable rate, we would be pleased to carry an insurance. I think it would come fairly within the scope of this organization to encourage the formation of any insurance company that can reasonably insure without any prejudice; and where we may not lend ourselves to the formation of a company, I see no reason why we should not encourage Mr. Gilbert in his enterprise.

Mr. Morrison: I would like to ask the reading of the resolution again. Before that is done I would like to ask Mr. Linnell whether the decision in Richmond of the six companies as to the rates charged was not merely the judgment of one man, and he the manager of the local combination?

Mr. Linnell: In reply, I would state that the policies were all issued through the agency of one man, as he suggests. Whether he was the committee of the board or not, I am not positive. But they certainly were obtained through his agency, and at the same time, from the fact that he interested himself in the obtaining of six different policies, it would seem that he was desirous of getting insurance for us, since we refused to insure longer than a given period of time until I could ascertain what action this meeting would take in relation to that tax.

The Secretary read the resolution.

Mr. King: I think, in a general way, our company would favor the organization of such an association as is proposed. In our case, our station is a brick building on the bank of a river. We have ample steam power, duplicate steam pumps, pipes carried through our machinery room, hand grenades, and other protections of that character throughout the building. The railroad track runs upon one side of our building,

and upon the other, for a hundred feet, is a very small planing mill. It is a one-story building. Five hundred feet distant is a saw mill. On the side exposed to the planing mill we have iron shutters. We have a gravel roof on the building. We took all the precautions we could think of for our own protection. We are paying $1\frac{3}{4}$ per cent., and we would like to reduce that, if we can, with Mr. Woodbury or some other man.

Mr. Gilbert: The thirty-one companies from whom I received communications are paying an average amount of one dollar and sixty-five cents. This matter I have brought before the Convention because those who replied to the letter seemed very much interested in it. I talked the matter over with Mr. English, and we did not know whether to discuss it here or not. As there seemed to be so much interest in the matter, we thought the proper place to bring it before the gentlemen concerned was here in this room.

Mr. Weeks: Our rate was fixed at $3.10 at Kansas City, and I called on the manager of the board, and told him if that was to be the rate we would carry our own insurance or go outside the board. It was finally readjusted at $1.45, which rate we are now paying on our insurance.

A Member: Is it not a fact that a large amount of money has been expended on our risks in order to get them into the manufacturing insurance companies?

Mr. Woodbury: Certainly.

A Member: If the Richmond risk, to which our friend refers, is rated at one and a-half, is it not possible that there may be an electric light station in the United States worth that rate to insure it?

Mr. Woodbury: I think so.

Mr. Mullen: It seems to me a matter of ignorance on the part of insurance companies as to the rate they charge. In such companies as the Imperial, of London; the London and Liverpool; the Globe, and the Niagara, I have just placed an insurance of three-fourths, which is the lowest I have ever placed. The usual rate with us is about one per cent.

MR. DE CAMP: I see no propriety in this Association endorsing that. It resolves itself into this: there may not be enough plants to respond and make it an object to form a company. Speaking for our own company simply, our rate is a reasonable one and as low, I think, as we can expect. I would have no objection to voting for that resolution with a little alteration—that the words, "the Chair appoint a committee of three to perfect such organization," be stricken out. We certainly can afford to endorse anything that is going to result to the benefit of our companies in reducing our expenses.

MR. CLEVELAND: Will you write that?

MR. DE CAMP: I will get at it by moving to strike out those words.

The amendment was seconded and adopted.

MR. CLEVELAND: The resolution now reads: "Resolved, that this Association endorse the plan of organization of a Mutual Electric Light Insurance Company." I want to say in justice to Mr. Gilbert—you do not know him as well as I do—he will not be likely to start an enterprise of this kind and give it up. Now we shall have a Mutual Electric Light Insurance Company I guarantee.

MR. MORRISON: The principle of endorsing the plan is the one to which I object. I object to the endorsement by this Association of any scheme outside of that for which the Association was organized. I, therefore, vote no.

The resolution, as amended, was carried.

THE PRESIDENT: The report of the committee on nominations is next in order.

MR. WEEKS: There is something that is preliminary to that. I move you that Article 4 of our Constitution be amended so as to read, "and seven members as an executive committee," instead of six. Under the article as it now stands amended, it is an even number, and it is preferable to have an odd number.

The amendment was adopted.

MR. KING: Your committee desire to say that to relieve the President of the great amount of labor

that falls upon his shoulders in the absence of the executive committee, and the difficulty of getting them together when they are in widely distant places, we thought it would be judicious to select a majority of the committee from localities where they may meet for consultation, when desired. The list is as follows: President, J. Frank Morrison, of Baltimore, Md.; Vice-presidents, E. R. Weeks, of Kansas City, Mo., H. M. Cleveland, of Hartford, Conn.; Teasurer, Charles Cooper, of Brooklyn, N. Y.; Executive Committee, George S. Bowen, of Chicago, Ill.; James A. Corby, of St. Joseph, Mo.; Frank Ridlon, of Boston, Mass.; George F. Fletcher, of Dayton, Ohio; E. T. Lynch, Jr., of New York; Dr. Otto Moses, of New York; A. J. De Camp, of Philadelphia, Pa.

MR. GILBERT: As there are no other nominations, I move that Mr. King (as the Secretary is in the chair) cast the ballot of the Convention.

The motion was carried.

MR. KING: I cast the ballot of the Association for the following officers: For President, J. Frank Morrison; for Vice-presidents, E. R. Weeks and H. M. Cleveland; for Treasurer, Charles Cooper; for Executive Committee, George S. Bowen, James A. Corby, Frank Ridlon, George F. Fletcher, E. T. Lynch, Jr., Dr. Otto Moses and A. J. De Camp.

MR. RIDLON: I would recommend that this Convention adopt a bureau of information which shall be to the Electric Light Association or its members the same as Bradstreets' is to mercantile houses, and to be in charge of the President and controlled by him. I offer this resolution:

Resolved, That the National Electric Light Association form a bureau for collecting and distributing information regarding electric light matters, which shall be under the control of the President, and that he employ a Secretary and rent a permanent office for the Association.

A motion was made to lay this resolution on the table. It was lost.

Mr. Cooper moved the adoption of the resolution.

The resolution was adopted.

THE PRESIDENT: I have ample powers to arrange for a bureau, but no money.

MR. DE CAMP: There is a committee, or there will be one, appointed on the basis of the resolution offered here early in the meeting—a committee of conference, it might be called, between the parent and sub-companies. It will take a little time to get that into shape and devise a proper method of proceeding. I have heard, since I have been in this Convention, from time to time, of one or two instances of cut-throat business, where two companies are trying to destroy each other. That would come within the scope of this committee to which I have referred. Somebody in a particular case is suffering now, and I would like to see a resolution passed expressing the sentiment of the Convention as being absolutely opposed to any such method of doing business.

MR. MORRISON: [Mr. Cleveland, Vice-president, in the chair.] The only case that I know of in that connection is the case of Mr. Maher, of Albany. Mr. Maher's company went to the expense of installing a plant in Albany some years ago. They had started lighting at fifty cents a lamp. The city purchased the plant necessary to do the work. There has been no question about the quality of the service. There has been, as I understand, no objection to the terms of the contract by the people of Albany until within the last few weeks. The Thompson-Houston have sent their agents into Albany, and are now holding a sort of Dutch auction. They are trying to bid down the electric light business. Now I am in favor of the passage of a resolution such as that suggested by Mr. De Camp. Here is one of the cases of mutual insurance that I stand ready to adopt at once. I am happy to say that I have had communications with members of this Association who are the chief officers of some of the subordinate companies of the Thompson-Houston system, and that these gentlemen have promised me that they will use their individual and official efforts upon their return to their respective

homes, through correspondence with their parent company, to dissuade them from this attempted piracy upon the legitimate business of the Electric Lighting Company of Albany. I know of no terms too strong, Mr. President, to use on an occasion of this kind. A set of gentlemen go into a city, expend their time and labor, and become the pioneers in an enterprise. They work the system up to a success, after overcoming various difficulties in establishing a company. They go along until the company is either a success or a failure. If it is a failure, then they have no opposition. If it is a success, then along comes some other company, and they sing the song of old Sam Brace, "It is my name; if you don't let me in, I will break up the game." Now, I want the members of this Association to put themselves plain and straight on record that they will not only not countenance such action on the part of any parent company, or on the part of any one engaged in such business, but that they will use their individual and official efforts to discountenance this sort of piracy on legitimate business.

Mr. Maher: The President has very kindly and fully expressed the condition of affairs as far as Albany is concerned, with the exception, possibly, of stating our present condition. The Albany company is operating four hundred and eighty-one city lights under a contract of five years, which will expire on the 21st day of next June. A year ago this month we went to the Board of Aldermen and asked them to pass a resolution authorizing the continuance of the lighting of the streets of the city. We went thus early for the reason that we were running four engines up to their full capacity, and, in case of an accident occurring to any one of them, we would be placed in rather a disastrous position, provided the accident was of any moment. In order to overcome that prospective difficulty, we wanted to put in a large engine capable of doing the work of two of the smaller ones, and to be able to have some reserve engine power. But we did not care to go to the expense of engine, boiler, dynamos, etc., without having some assurance that

we were to have a continuance of our contract. The Board of Aldermen, by a unanimous vote, authorized the Board of Contracts and Apportionment of our city, which has the charge of the letting of contracts (the Board consisting of the Mayor, the President of the Board of Aldermen, the City Chamberlain and the City Engineer and Surveyor), to enter into a contract for lighting the streets for five years from the 21st of next June. Bids were advertised for, and we were the only bidders. A committee of what is termed the Citizens' Association of Albany asked the electric light companies to have placed a restriction that the number of lights be confined to the number existing at that tlme, which was four hundred and thirty-one. The Electric Light Company, through its officers, said that they were perfectly satisfied, provided the city officers were. But before any action had been taken by the Contract Board as to the letting of this contract, the Board of Aldermen became aware of the desire of this Citizens' Association, and at a meeting passed by unanimous vote a resolution directing the Board of Contracts and Apportionment not to limit the number of lights. The Citizens' Committee commenced a suit—under what is known in New York as the Tilden act, whereby a citizen has a right to commence a suit against a corporation—against the city of Albany and our company as co-defendant, charging collusion and fraud, and charging that the officers of the Electrical Company were men of strong political influence, and such nonsense as that. The case was tried on the first Monday of October last. The court declared the contract illegal, but not upon any of the grounds charged in the complaint of this Citizens' Association, excepting one, which was that the notice, that the Contracting Board is obliged to publish in the official papers in the city, was not published a sufficient length of time. The notice was in conformity to all such notices for all contracts let under the new charter of the city of Albany, which has been in effect for about three years. The consequence was that our contract was set aside; and all

contracts let since that charter went into effect have been declared illegal. When I left home the corporation counsel of the city of Albany was preparing a bill asking the Legislature to legalize the action of the Board of Contracts and Apportionment in relation to all these contracts. There is a decision of the Court of Appeals which is to the effect that a corporation in the State of New York working any particular patented article has a right to choose any particular business using that patent. This referred to a case where they were paving certain streets in the city of New York with a particular kind of pavement, and the Court of Appeals held that the board of that city which had charge of the letting of the contract was not obliged to advertise for bids, as there would be no competition, this company having the sole control of that particular system of pavement. Under that decision the Board of Aldermen passed a resolution directing the Contract Board of the city to enter into a contract for lighting our streets with the system known as the Brush system, and under that resolution the Board of Contracts asked for proposals for bids by that system. We, of course, have control of that system in the city and county of Albany, and did not expect any bids from other parties. Bids were to be received a week ago last Monday al 11 o'clock, and to our great surprise we found two other bidders. The Mayor, who is chairman of the Contract Board, refused to receive those bids on the ground that they were informal and did not conform to the specifications which required bids by the system known as the Brush system. We feel perfectly secure in our position, and I want to say further that we have our contract, signed by the Mayor, in my safe at Albany. We feel that under the decision of the Court of Appeals we are perfectly secure against any trouble excepting that to which we may be subjected through litigation in the courts. But we think it is unfair, under the circumstances, for any company to come into competition with us. It is a physical impossibility to put up a plant and get ready to light the streets of Albany by the

time that our present contract expires. It places us in a position that in the future we shall be obliged to reduce the price of our lighting. The competition is not fair, nor was it intended to be fair when the bid was put in.

Mr. Cleveland: I would say but a word or two. I had something to say on this question at the last Convention in New York, and I most heartily agree with the President in what he has said. I do not know anything too severe to say of a manufacturing company that will enter a field already occupied and demoralize and destroy property in the electric lighting business. Now, that does not mean that there should be no competition in soliciting business. I know of a city in New England that has within a very few days given three electric manufacturing companies the right to put in plant. That is fair play.. Let the fellows pitch in. They are on an even footing. But after a plant is in and stock taken, earning perhaps fair dividends, for some other company to go in and demoralize the property that already exists is an outrage. I do not hesitate to say that a company that will do that is a dishonorable company. It is unfair. It is a mean thing to do. The result is the same as in the case of a parallel road. I need not stop to tell you about those things. If such a company only lost its own money, that would be one thing. I hope that this Association will sit down on this thing as hard as the President sometimes does on us if we do not behave well.

Mr. Cooper: I noticed that the company that is called to task in this matter is the Thompson-Houston Company, of Boston, and as the president of a local company that has been using for years the next to the largest number of Thompson-Houston lights in the United States, I will say that I heartily endorse what the gentleman preceding me has said. I am simply the representative of a local company that buys from the parent company the same, as I understand, the rest of the Brush people do. But it is not limited to the Thompson-Houston Company. We have an illustration of it in the case of our friend from whom we

always receive long telegrams, but whom we have never had the pleasure of seeing at the Convention—Mr. Goff—who only two or three weeks ago organized ten companies in New York State, and, I think, nine out of the ten territories were already occupied. He has organized one in Brooklyn. That treads on my toes. I am afraid he will get in. When he does we will have a little fight. I most sincerely endorse all the gentleman has said; and if the Thompson-Houston Company is responsible for it, I think it should be censured, and I shall make it my duty to send word to that effect.

Mr. Maher: I desire to say that the Thompson-Houston Company is responsible.

Mr. Weeks: I go farther than the previous speaker, and say that I will not only send word, but I will go, as soon as this Convention closes, to Boston, and will personally remonstrate with them in regard to their conduct, and I will back up my remonstrance with a very sad experience in Kansas City. Not long ago our gas works exploded. There was a city of very nearly 150,000 inhabitants in darkness, excepting those portions of it lighted by us. The consequence was that the temptation was too great for these other companies. The United States, the Sperry, the Sawyer-Mann, the Edison, and others, all sent representatives to the town to organize companies and put in a plant. It placed us in a very trying position; but we held the fort, and I think we can continue to hold the fort. We do not propose to be beaten out of it any way. If any one comes in there to fight us, we will meet him. We are a strong resident corporation. Our stock is owned in the city, and we do not propose to let any one take our patronage away. I feel deeply on this matter, because it comes right home to me. I do think that any such conduct is dishonorable, and I shall take the officers of the parent company to task for their conduct in Albany. I think that I can show them that it is ultimately in conflict with their interests. It tends to cheapen the value of electric light, and thereby injures the whole industry. As long as this

custom prevails, as long as there is danger of this cut-throat business, none of us will put any more money into it. I think that the resolution is a very important one, and while I do not expect that we will be able to do very much under it at once, I think that eventually we can do a great deal for the benefit of the members of the Association.

MR. H. W. POPE: In relation to Mr. Goff: Coming down on the elevated road the other day, I met a gentleman from Newburgh, who said to me that Mr. Goff had incorporated a company for the city of Newburgh. I do not know what the populatian of Newburgh is, but it probably does not exceed ten thousand inhabitants. There is an incandescent branch (Edison's) in Newburgh, also a Thompson-Houston arc company. Now, this cut-throat business extends a great deal further than the mere competition between the lighting companies. I understand that the carbon people are directly interested in this cut-throat business, in connection with the Goff Company. The Holmes, Booth & Hayden's people, by being connected with that company, are directly interested in this cut-throat business, and the thing extends right into the wire—into everything that pertains to the electric light business. We find carbon-men selling wire and all that sort of business. It seems to me that these people interested in the carbon business, who are doing what they can to interfere with the arc lighting business, should be known to this Convention.

MR. GILBERT: Referring to what Mr. Cooper said about Mr. Goff, I had some dealings with him last week in Albany. I think it is no more than fair to state that although the business was to be opened at 10 o'clock on Monday, and that he had an invitation from one of the companies in Albany to come there and bid on those lights, he declined. I do not think Mr. Goff's ten companies are to be located right where the newspaper places them all. Mr. Goff told me on Thursday, before the bids were opened in Albany, that he would not put in a bid.

Mr. Cooper: I think all the members know that Mr. Goff has filed papers for the organization of business in different parts of New York. I informed Mr. Adams, one of the directors of the company, that we would buy no more wire from him. He said he had acted in the matter under obligations to Mr. Goff. I do not believe Mr. Goff intends operating all the companies; but I believe he intends to float his debenture bonds, which are a fraud on the public. I wish to put that in big letters, and have it said that Mr. Cooper said so.

Mr. Linnell: I would like to say one thing in Mr. Goff's favor, and it is this: That although the methods he may use in regard to his business ventures are not, perhaps, those which every conservative business man would approve of, yet, at the same time, in my opinion, he is a man with some good points; and I do not think he stands in any different position in relation to cut-throat business than any one else. When he got out his charters for his different New York State companies, among them were two places in which we had commenced to work. As soon as Mr. Goff learned of that fact, he voluntarily withdrew his men, pigeon-holed his certificates of incorporation, and gave up the idea of attempting to do anything in those places. I think this proves that he has the same views in relation to this cut-throat business that any one else has.

In regard to this Albany business, I think that Mr. Maher is perfectly correct in his ideas. At the same time, I do not think that the Thompson-Houston people, under the circumstances, are entirely to be blamed. The blame for that lies with certain individuals in the town of Albany, who assume a high moral tone, and call themselves a Committee of "Investigation and Censure." They announced the fact that they intended to bid through some other company, and came to the Schuyler and presented the matter to them and said: "Will you put in a bid under these circumstances?" This we refused to do. We certainly did not care to go in there under any circumstances. At the same time

they said: "If you do not accept, we shall find another company who will." Consequently, I do not think the Thompson-Houston Company had any idea of cut-throat business, even if they did go into that. But they said some one else will possibly sell machines to this committee; and, consequently, if we can sell ours for cash in the city of Albany, we may as well do so. I know personally that that committee has offered steam power to whomsoever would come in and compete with the local company; and held out the inducement that the plant would not be in the hands of the parent company very long.

MR. DE CAMP: By whom was the proposition made?

MR. LINNELL: I would not like to give any names. It was made by individuals in Albany.

MR. DE CAMP: It was a very funny way of doing it, if they did not want the business. I understood you to say, as an excuse for those people bidding, that they had been importuned by people in Albany to make a bid. I understood that you declined.

MR. LINNELL: That was the verbal statement made to us, sir.

MR. DE CAMP: This company said, "We do not want it, but we will bid?"

MR. LINNELL: No, they did not say that. They said if any one wants to buy apparatus in the city of Albany, we are ready to sell. You can readily realize that an understanding of that sort could be very easily made an excuse.

MR. DE CAMP: I think the act was very reprehensible on the part of the parent company.

MR. LINNELL: I think the quoting of prices was decidedly so.

MR DE CAMP: If it had not been for the quoting of prices there would have been no trouble.

MR. LINNELL: It is only on the matter of quoting prices that I censure them. I do not censure them for offering to supply them when they were requested.

MR. MAHER: This bid of the Thompson-Houston, of Boston, was direct. They offered to light the city, and the communication was signed by Mr. Barton as treasurer and general manager, who was authorized by his

board of directors to sign with the seal attached. I saw the bid. It was not for some Albany people. There is no company organized in Albany except our own. The bid was from the Thompson-Houston Company, of Boston, not any local company. Nor did they make any offer of machines or anything of that kind. The offer was to light the city of Albany for five years for forty-seven and a-half cents per light per night, and signed on behalf of the Thompson-Houston Company of Boston.

MR. GILBERT: I would like to cite a case that happened in New England within the past year. There is a company running a different system from ours who, as I am told, offered, after they had established their plant in the city, to sell it to the gas company at a fair price. The gas company refused to buy it. After the contract expired, and the city advertised for bids, the gas company went to the president of another electric light system and said they wanted to ascertain the actual cost of running so many city lights. The president of that company prevailed on him to let him know what they wanted the information for, and they said that when they ascertained the actual cost they intended to put in a bid at ten per cent. lower, in order to drive out the existing companies. When the president of the company ascertained this, he immediately went to the parent company, and left word that in case the gas company came there for a machine, and they sold it, he would not buy another machine of them. It was not for the interest of electric lighting, and, therefore, there must be some means taken to prevent the parent company selling machines to the gas company. I think that is a case that this committee spoken of can take up. This mutual insurance ought to protect us all. I think our interests need to be protected. I think that committee ought to be appointed.

MR. MAHER: I desire to say just one word more. It may not be generally understood by the members of this Association that the city of Albany owns the lamps, the wire, the poles and the lamp-posts. At the

time that our contract was first made the proposition was suggested that we should own the lamps, do our own work, and charge a price which, of course, was considerably in excess of the price now paid. After a mutual understanding it was agreed that the city should own the lamps, the posts, the wire and the poles, and pay us seven dollars a year per lamp for repairs. So really the price is about the same as that paid in other cities under other circumstances. We get fifty cents.

Mr. Cooper: I do not wonder that you want to hold on to the contract.

Mr. De Camp: Allow me to ask you—the substitute proposed was that they are to allow seven and a-half cents per lamp?

Mr. Maher: Yes, sir.

Mr. De Camp: In that case it would make the whole price fifty-seven and a-half cents. I don't see anything bad about that one way or the other. It is a fair contract.

Mr. King: I am heartily in sympathy with this movement, because in our city we have had just this fight for nearly four years. We found a gas company there with an exclusive franchise. We waited three months, got our ordinance from another Mayor, put up our light, obtained permission to erect a mast, which we did, and proposed that they should rent it. The gas company served notice on the city that they had owned that city for fifty years. The city made a contract with us. They kept that gas burning till last summer, when we applied to the city for a contract of some consequence. We had been running some twenty odd lights. We had the only plant in the city, and no other company was represented there. At that critical moment to us, the representative of another company and the gas company wanted to make a bid. Now, I want to sit down on that sort of thing.

Mr. Ridlon: I move that a committee of five be appointed by the Chair to raise funds for carrying on the bureau that has been established.

The motion was carried.

MR. RIDLON: The committee to which the subject of standard carbon was referred report as follows:

Resolved, That the following be adopted by this Association as a test of standard carbon: Take a dynamo machine, with its full complement of lamps, and trim the lamps with the same make of carbons; note the speed of the dynamo carefully, and during the test measure the current at frequent intervals with an ammeter; see that all the lamps burn freely, without hissing, and yet not with arcs so long as to flame. Measure the E. M. F. around each arc with a volmeter. Burn the lamps until all the carbons are consumed, or burn them, say, for four hours, and then measure the length of carbons consumed, and calculate the total time that they would burn, taking the average result.

The resolution was adopted.

THE PRESIDENT: I will appoint the following committee to raise funds for carrying on the bureau referred to in Mr. Ridlon's resolution: Messrs. Ridlon, of Boston; Kirby, of St. Joseph; Price, of New York; Martin, of New York; Bowen, of Chicago; De Camp, of Philadelphia; Cooper, of Brooklyn; Goff, of New York, and Cleveland, of Hartford.

DR. MOSES: Before the adjournment, will you permit me to offer the names of three gentlemen who, I think, are entitled to the honor of being made members of this Association? They are foreigners—at the present moment residents of Paris. These three gentlemen are engaged in the development of the transmission of force to a distance, which, as I had occasion to remark, I think to be one of the most important features now being treated of in science. One of them is attacking the scientific part of it. The other gentleman, with characteristic energy, is sustaining him in that movement, and the third furnishes the capital for it. I would like to have the pleasure of proposing the names of M. Marcel Deprez, Dr. Cornelius Herz, the editor and proprietor of *La Lumière Electrique*, and the Baron Alphonse de Rothschild, who has contributed the funds necessary for these experiments with a most lavish hand.

Mr. Martin: May I, in supporting the motion, be allowed to inform Dr. Moses that I had not the least intention in my paper to depreciate the value and importance of the work of M. Deprez. It was simply an expression of opinion that it might be attempted by him in other directions; and for that reason I desire to support the resolution, particularly with regard to M. Marcel Deprez himself, as an assurance of the very high esteem with which I regard him and his work.

The resolution was carried.

The Convention then adjourned *sine die.*